COLUMBIA RIVER BASIN - SYSTEM CONFIGURATION STUDY

Snake River Drawdown, Migratory Canal, Upstream Collector

Planning Aid Report

For

U.S. Army Corps of Engineers
Walla Walla District
Walla Walla, Washington

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INTRODUCTION

This Planning Aid Report (PAR) is provided to the U.S. Army Corps of Engineers, Walla Walla District, to assist with reconnaissance-level planning for the System Configuration Study (SCS), which is a component of the Columbia River Salmon Mitigation Analysis (CRSMA). A preliminary draft and draft of the PAR were circulated for review and comment, and comments have been incorporated or addressed in the PAR. The SCS is evaluating physical changes to the configuration of the Columbia River System for the purpose of improving survival for anadromous fish. The proposed changes include modification of spillways, powerhouses and associated structures on the lower Snake River, and the construction of additional dams and structures which would permit modifications in present system operation.

This specific PAR addresses the lower Snake River drawdown alternatives and the upstream collection and transport alternatives, including the migratory canal and tube. In addition, specific requests have been made from the Columbia-Snake River Drawdown Committee to evaluate designs for a side-channel spillway and downstream weir at each of the lower Snake River projects. These elements were not addressed in the preliminary draft of the PAR. Other elements of SCS, such as the John Day drawdown and upstream storage, are being addressed by the Portland and Boise Fish and Wildlife Ecological Services Offices of the U.S Fish and Wildlife Service.

The objectives of this PAR are to: 1) Describe relevant fish and wildlife populations and habitat within the study area; 2) Describe future fish and wildlife habitat conditions without the project; 3) Appraise existing fish and wildlife utilization; 4) Evaluate impacts of project alternatives on fish and wildlife resources; 5) Identify data gaps and study needs which need to be addressed during feasibility; and 6) Identify potential mitigation opportunities and requirements.

In order to evaluate a full range of alternatives to improve the survival of anadromous fish stocks in the Snake River, this PAR also recommends that alternatives to evaluate the removal of one to four dams on the lower Snake River, and permanent, partial drawdowns be included in the range of alternatives under consideration. The need to consider these alternatives has become evident as uncertainties associated with the initially proposed alternatives have developed.

STUDY AREA

The study area has been thoroughly described in the Columbia River Salmon Flow Measures EIS (USACE 1992a), and only pertinent information will be presented in this report. For this report, the study area is defined to be the lower Snake River and adjacent terrestrial habitats, and the migratory canal right-of-way and adjacent area which would be affected.

Climatic conditions within most of the study area are characterized by generally arid conditions with hot, dry summers and relatively cold winters. Most precipitation falls during the winter. Normal rainfall ranges from 7 inches at

Kennewick, Washington, and 10 inches at The Dalles, Oregon, to 14 inches at Lewiston, Idaho. Much wetter conditions prevail at the Bonneville project, where the Columbia River passes through the Cascades.

Vegetation within the study area falls primarily within the steppe and shrub-steppe zones, which are dominated by sagebrush (*Artemisia* spp.) and bitterbrush (*Purshia tridentata*) (Franklin and Dryness 1973). As rainfall increases west of The Dalles, forests of ponderosa pine (*Pinus ponderosa*)-Oregon white oak *(Quercus garryana)* prevail, with Douglas fir (*Pseudotsuga menziesii*) becoming predominant at Bonneville Dam.

The Columbia River System, which drains the study area, has been largely converted to a series of slack water reservoirs (Appendix A). The lower Snake River projects include Ice Harbor (RM 10), Lower Monumental (RM 41), Little Goose (RM 70) and Lower Granite (RM 108) Dams. Project information is summarized in Table 1. All are run-of-river projects, whose authorized uses are power generation, navigation, irrigation, recreation and fish/wildlife. Ice Harbor and Lower Monumental dams are operated within a 3-foot range and Little Goose and Lower Granite are operated within a 5-foot range, although they have been typically operated at minimum operating pool (MOP) during fish out-migration in the recent past. Mean annual flow at Ice Harbor for the period of July, 1928 to June, 1968 is 47,680 cubic feet per second (cfs) (USACE 1992a).

Columbia River projects which have adjacent lands within the migratory canal study area include Bonneville (RM 146), The Dalles (RM 166), John Day (RM 218) and McNary (RM 293) projects. These are primarily run-of-river projects whose authorized uses include power generation, navigation, recreation, fish and wildlife, and irrigation. John Day also provides some storage for flood control. With the exception of John Day, these projects have a normal operating range of 5 feet. John Day has an operating range of 11 feet, although it is typically operated at the upper limits of its range.

PROJECT DESCRIPTION

Snake River Drawdown

Twenty alternatives involving alterations of projects on the lower Snake River were initially proposed. An initial screening of these alternatives by the Technical Advisory Group (TAG) resulted in a reduction of the number to 9 alternatives (Table 2). Many of the alternatives were eliminated because of impacts to adult anadromous fish passage, impacts to juvenile salmonid passage because of gas supersaturation beyond acceptable levels, or reliance on unproven or no longer accepted technology. The selected alternatives can be divided into three categories: 1) natural river, 2) variable pool and 3) constant pool.

All of the proposed alternatives involve drawdowns, ranging from 28 feet to greater than 76 feet below normal minimum operating pool. Alternatives would be implemented either over a 2 or a 4.5 month period, after which the reservoirs would be returned to a normal operating elevations. The variable pool alternatives allow the river to fluctuate depending on river flow or discharge.

e 1. Summary of pertinent project data and operating limits (fmsl). (From USACE 1992a)

ct	Upstream						Downstream		
	Maximum Operating Pool Elevation A	Minimum Operating Pool Elevation B	Downstream Juvenile Fish Intake Center Line C	Adult Fish Ladder Exit Invert Elevation D	Navigation Lock Sill Upstream Elevation E	Spillway Crest Elevation F	Maximum Operating Pool Elevation G	Minimum Operating Pool Elevation H	To Adu La G
mbia River									
eville	76.5	70.0	65.5	63.0	40.0	24.0	27.0	10.0	2
Dalles	160.0	155.0	151.0[b]	147.0	140.0	121.0	85.0	75.0	6
Day	268.0	257.0	250.4	250.5	242.0	210.0	166.0	157.0	15
ary	340.0	335.0[c]	330.0	330.0	320.0	291.0	269.0	264.0	25
e River									
larbor	440.0	437.0[c]	431.5[b]	431.0	422.0	391.0	346.0	340.0	33
er Monumental	540.0	537.0[c]	531.5	530.5	521.0	483.0	442.0	439.0	43
e Goose	638.0	633.0[c]	628.9	627.0	618.0	581.0	541.0	538.0	53
er Granite	738.0	733.0[c]	729.0	727.0	718.0	681.0	638.0	633.0	62

Fish ladder floor elevation; no minimum tailwater requirement for fish ladder operation.

Top of sluiceway.

Minimum forebay elevation used for design of existing fish passage facilities which corresponds to current minimum operating pool (MOP).

TABLE 2 – INITIAL SCREENING (From USACE 1992c)

Number	Description	Drawdown Level (feet) (Note 1)	Recommendation For Further Study
	VARIABLE POOL – NO POWERHOUSE OPERATION		
1	Existing Spillway Only	28 – 57	Eliminated
2	Modified Spillway Only	38 – 67	Eliminated
3	New Low Level Spillway Only	52 – 76	Eliminated
4	Auxiliary Regulating Outlet (ARO) Only	> 76	Eliminated
4A	Natural River Option	Near Freeflow	Added
	VARIABLE POOL WITH EXISTING POWERHOUSE		
5	Existing Powerhouse with Existing Spillway	28 – 57	yes
6	Existing Powerhouse with Modified Existing Spillway	38 – 67	Eliminated
7	Existing Powerhouse with New Low Level Spillway	52 – 76	Eliminated
8	Existing Powerhouse with ARO	> 76	Eliminated
	VARIABLE POOL WITH MODIFIED POWERHOUSE		
9	Modified Powerhouse with Existing Spillway	28 – 57	yes
10	Modified Powerhouse with Modified Existing Spillway	38 – 67	Eliminated
11	Modified Powerhouse with New Low Level Spillway	52 – 76	Eliminated
12	Modified Powerhouse with ARO	> 76	Eliminated
	CONSTANT POOL WITH EXISTING POWERHOUSE		
13	Existing Powerhouse with Existing Spillway	33	yes
14	Existing Powerhouse with Modified Existing Spillway	43	yes
15	Existing Powerhouse with New Low Level Spillway	52	yes
16	Existing Powerhouse with ARO	52	Eliminated
	CONSTANT POOL WITH MODIFIED POWERHOUSE		
17	Modified Powerhouse with Existing Spillway	33	yes
18	Modified Powerhouse with Modified Existing Spillway	43	yes
19	Modified Powerhouse with New Low Level Spillway	52	yes
20	Modified Powerhouse with ARO	52	Eliminated

ote 1. For reference, a 57 foot drawdown represents an upstream pool at a level equal to the existing spillway crest at Lower Granite Dam.

Constant pools would be operated under a drawdown condition, but within a 5-foot operating range, as presently occurs. The natural river flow alternative returns the river to a flow as near as possible to natural conditions. The modifications required to the projects are discussed briefly below. Design and operation features are described in detail in the CRSMA-SCS Phase I, lower Snake Reservoir Drawdown-Design and Operation Plan.

The natural river alternative (Alt. 4A) would involve construction of structures at all of the lower Snake River projects, which would permit flows to bypass the powerhouse and spillways. Construction would also include a stilling basin downstream of the bypass structures. Tainter gates on the bypass structures would be opened no later than February 16 to permit a controlled lowering of the pools to natural flow conditions by April 15. Refill time would depend on inflows. Construction of the tainter gates would require major channel excavation at Lower Monumental and Ice Harbor Dams and removal of embankments at Little Goose and Lower Granite Dams. Several other structures, such as adult fish passage facilities and the existing stilling basins, would have to be modified.

The variable pool alternatives include a 28-57 foot drawdown without modification of the existing powerhouses or spillways (Alt. 5) and a 28-57 foot drawdown with powerhouses modified to operate efficiently at spillway crest (Alt. 9). Under these alternatives, the powerhouses would be operated at a head not less than the existing spillway crest. Flows in excess of unit operation integrity would pass as unregulated spill. Pool elevations fluctuations above spillway crest would be a function of river discharge.

System modifications which would be required include a new low level pressurized juvenile bypass system, low level tailwater adult fishways, and spillway modifications. Modification of existing vertical barrier screens or new barrier screens would be required. Summaries of these alternatives and the required project modifications are presented in Table 3.

The constant pool alternatives for the lower Snake River projects would consist of drawdowns of 33 feet using the existing spillway (Alt. 13 and 17), 43 feet with a modified spillway (Alt. 14 and 18) and 52 feet with a new low level spillway (Alt. 16 and 19).

Alternatives include operation with modified and existing powerhouses. Water in excess of unit operation integrity would be passed as regulated spill. Drafting would begin no later than March 29 to achieve target drawdown elevations by April 15 of each year. Refill time would depend on inflows.

The constant pool alternatives would require a number of project modifications. A new, lower level juvenile bypass system would be required. The collection channel would be open and collection gallery depth would be controlled by a dewatering device. New vertical barrier screens would need to be designed and prototype tested. New low-level adult facilities, which would include auxiliary adult exits with a false weir and return flume, would be needed. Other major modifications would include stilling basin modifications at Little Goose dam and installation of spillway drum gates at Lower Granite, Little Goose and Lower Monumental dams.

TABLE 3 – PROJECT MODIFICATIONS (From USACE 1992c)

LOWER GRANITE DAM

Feature	Modification	Alternative 4A	5	9	13	14	15	17	18	19
Existing Spillway	Lower Crest 1/					X			X	
	Drum Gates 2/	X	X	X	X	X	X	X	X	X
	Stilling Basin 2/									
	Gates/hoists					X			X	
Adult Fish Passage	New Adult Ladder	X	X	X	X	X	X	X	X	X
	Secondary Ladder Exit		X	X	X	X	X	X	X	X
	Auxiliary Exit	X	X	X	X	X	X	X	X	X
	Entrances & Collection System 2/	X	X	X	X	X	X	X	X	X
Powerhouse	New Turbine Runners			X				X	X	X
New Spillway 1/	Six New Bays with Gates						X			X
Juvenile Fish Passage	Collection Channel		X	X	X	X	X	X	X	X
	Vertical Barrier Screens		X	X	X	X	X	X	X	X
	Transportation Channel		X	X	X	X	X	X	X	X
River Bypass	Bypass Structure 1/	X								
	Channel Excavation	X								
Embankment Protection	Dam Embankments Railroad, Highway Fills Levees	X	X	X	X	X	X	X	X	X
Miscellaneous Modifications	Nav Lock Guide Wall Debris Shear Boom Culvert Outfalls	X	X	X	X	X	X	X	X	X
Real Estate Acquisition & Relocations	Roads/Railroads Visitor Facilities	X					X			X

LITTLE GOOSE DAM

Feature	Modification	Alternative 4A	5	9	13	14	15	17	18	19
Existing Spillway	Lower Crest 1/					X			X	
	Drum Gates 2/	X	X	X	X	X	X	X	X	X
	Stilling Basin 2/	X	X	X	X	X	X	X	X	X
	Gates/hoists					X			X	
Adult Fish Passage	New Adult Ladder	X	X	X	X	X	X	X	X	X
	Secondary Ladder Exit		X	X	X	X	X	X	X	X
	Auxiliary Exit	X	X	X	X	X	X	X	X	X
	Entrances & Collection System 2/	X	X	X	X	X	X	X	X	X
Powerhouse	New Turbine Runners			X				X	X	X
New Spillway 1/	Six New Bays With Gates						X			X
Juvenile Fish Passage	Collection Channel		X	X	X	X	X	X	X	X
	Vertical Barrier Screens		X	X	X	X	X	X	X	X
	Transportation Channel		X	X	X	X	X	X	X	X
River Bypass	Bypass Structure 1/	X								
	Channel Excavation	X								
Embankment Protection	Dam Embankments Railroad, Highway Fills Levees	X	X	X	X	X	X	X	X	X
Miscellaneous Modifications	Nav Lock Guide Wall Debris Shear Boom Culvert Outfalls	X	X	X	X	X	X	X	X	X
Real Estate Acquisition & Relocations	Roads/Railroads Visitor Facilities	X					X			X

1/ Requires Both Upstream and Downstream Cofferdams.
2/ Requires Downstream Cofferdams only.

TABLE 3 – PROJECT MODIFICATIONS (Continued)

LOWER MONUMENTAL DAM

Feature	Modification	Alternative 4A	5	9	13	14	15	17	18	19
Existing Spillway	Lower Crest 1/					X			X	
	Drum Gates 2/	X	X	X	X	X	X	X	X	X
	Stilling Basin 2/									
	Gates/hoists					X			X	
Adult Fish Passage	New Adult Ladder									
	Secondary Ladder Exit		X	X	X	X	X	X	X	X
	Auxiliary Exit	X	X	X	X	X	X	X	X	X
	Entrances & Collection System 2/	X	X	X	X	X	X	X	X	X
Powerhouse	New Turbine Runners			X				X	X	X
New Spillway 1/	Six New Bays With Gates						X			X
Juvenile Fish Passage	Collection Channel		X	X	X	X	X	X	X	X
	Vertical Barrier Screens		X	X	X	X	X	X	X	X
	Transportation Channel		X	X	X	X	X	X	X	X
River Bypass	Bypass Structure 1/	X								
	Channel Excavation	X								
Embankment Protection	Dam Embankments Railroad, Highway Fills Levees	X	X	X	X	X	X	X	X	X
Miscellaneous Modifications	Nav Lock Guide Wall Debris Shear Boom Culvert Outfalls	X	X	X	X	X	X	X	X	X
Real Estate Acquisition & Relocations	Roads/Railroads Visitor Facilities	X					X			X

ICE HARBOR DAM

Feature	Modification	Alternative 4A	5	9	13	14	15	17	18	19
Existing Spillway	Lower Crest 1/					X			X	
	Drum Gates 2/									
	Stilling Basin 2/									
	Gates/hoists					X			X	
Adult Fish Passage	New Adult Ladder									
	Secondary Ladder Exit		X	X	X	X	X	X	X	X
	Auxiliary Exit	X	X	X	X	X	X	X	X	X
	Entrances & Collection System 2/									
Powerhouse	New Turbine Runners			X				X	X	X
New Spillway 1/	Six New Bays With Gates						X			X
Juvenile Fish Passage	Collection Channel		X	X	X	X	X	X	X	X
	Vertical Barrier Screens		X	X	X	X	X	X	X	X
	Transportation Channel		X	X	X	X	X	X	X	X
River Bypass	Bypass Structure 1/	X								
	Channel Excavation	X								
Embankment Protection	Dam Embankments Railroad, Highway Fills Levees	X	X	X	X	X	X	X	X	X
Miscellaneous Modifications	Nav Lock Guide Wall Debris Shear Boom Culvert Outfalls	X	X	X	X	X	X	X	X	X
Real Estate Acquisition & Relocations	Roads/Railroads Visitor Facilities	X					X			X

1/ Requires Both Upstream and Downstream Cofferdams.
2/ Requires Downstream Cofferdams only.

Upstream Collection and Transport

One or more upstream collection facilities have been proposed to divert juvenile anadromous fish and river water. The fish would be diverted into holding facilities for transportation by barges or net pens, or into the migratory canal or flexible in-reservoir tube for passage to below Bonneville Dam. This facility(ies) would be located above Lower Granite Dam near the confluence of the Snake and Clearwater rivers. A site at Silcott Island on the Snake River was selected for design purposes to demonstrate the feasibility of the upstream collection concept (Project designs are provided in CRSMA - SCS Phase I, Lower Snake Reservoir Drawdown-Design and Operation Plan). An alternate system would have collectors at Ten-Mile Rapids on the Snake River and River Mile 6 of the Clearwater River. Fish lifts would be required with the collection system at Ten Mile Rapids and the Clearwater River Sites.

The fish collection facility would consist of several elements:

1. Juvenile Fish Barrier Screens - This screen would consist of 10,000 linear feet of removable fixed vertical wedge wire screen sections. These sections would be made of smaller screen sections 70 feet high by 50 feet wide. A brush (or other) cleaning system would require an overhead crane and access road.

2. Bypass Channel - A bypass channel comparable in size to the existing river channel would be excavated around Silcott Island.

3. Adult Fish Barrier Screens - The adult fish barrier screens on the excavated bypass channel would consist of 3,000 linear feet of removable fixed grating type screen sections. The sections would be similar to the juvenile fish sections and composed of smaller screen sections.

4. Trash-Shear Boom and Debris Removal System - A 4000 foot long trash-shear boom would be installed upstream from the fish collection facility.

5. Fish Sorting and Transfer Station - A juvenile fish sorting and transfer station would be present on each side of the river. These would include a number of components.

    a. Fish attraction channel - A 100-foot long, 8-foot wide and 20-foot deep channel would be excavated that would have velocities of a minimum of five feet per second. This would theoretically attract juvenile fish into the collection facility.

    b. Fish sorting and transfer station - This chamber would be 240 feet long by 100 feet wide by 80 feet deep. Within this chamber would be the stage two and three dewatering systems, the steelhead and chinook separators, the entrance to the adult fish return ladder, and the interior fish transfer channels and related components.

        1) Stage 2 Dewatering - This would be a 140-foot long by 8-foot wide inclined screen with a screen cleaning device and a pumped water withdrawal system of 560 cubic feet per second

(cfs) to create the proper attraction velocities in the fish attraction channel previously described. The upstream end of the screen would be a pivot point to allow the entire screen to adjust up and down with the 5-foot fluctuation in the river surface elevation.

2) Stage 3 Dewatering - This would be a 10-foot long by 8-foot wide extension of the stage two dewatering screen, which would have an independent pumped-water control system that would fine tune flows into the separators. The downstream end of the screen would be adjustable so that it could fluctuate with changes in water elevation.

3) Steelhead and Chinook Separator - This is a 21-foot long by 8-foot wide wet separator with separator bars comparable to the designs to be installed at Lower Monumental and McNary Dams. However, after the fish pass through the separator bars, they would swim into large holding structures below the separator bars. These holding structures would have pumped inflow and withdrawal systems that would be used to attract and distribute the fish within the channels in order to minimize stressful conditions.

4) Interior Transfer Channels - The floating interior transfer channels would be 21 feet wide by 50 feet long by 12 feet deep. Water within the channel would be about 10 feet deep. The transfer channels would have a system of pumped attraction and withdrawal flows, screens, a crowder and bulkheads, which would be used to move fish to the exterior transfer channels.

5) Exterior Transfer Channels - The floating exterior transfer channels would be 21 feet wide by 80 feet long by 12 feet deep which would match the interior transfer channel widths. Water depth would be about 10 feet. A system of screens, crowders and bulkheads would be used to move fish from the exterior transfer channels to the fish transport vehicles.

Migratory Canal

The migratory canal was evaluated during initial screening, but was dropped from further consideration after a preliminary review and preparation of the preliminary draft of the PAR. A description of the proposal and consideration of its benefits and effects are provided here, however, to provide the documentation on the justification for its elimination from further consideration.

The migratory canal would extend from the fish collection facility(ies) to below Bonneville Dam, where it would empty into the Columbia River. The alignment follows the Snake and Columbia Rivers. It is a combination of open canals, tunnels and enclosed culverts over draws, depressions and stream crossings. A portion of the alignment along the Snake River is in tunnels, while the Columbia

River portion would be primarily open canal. Project designs and alignment are described in the Columbia River Salmon Mitigation Analysis-System Configuration Study-Phase I Interim Status Report.

Water flow requirements for the canal are 200 cfs at 3-6 ft/sec velocities, while providing 2.0 ft/sec or less in rest areas. A 25 percent exchange of water at each resting pond is also planned. Water quality requirements include maintaining water temperature within 2°F of river temperature, not permitting pressure changes greater than 0.5 atmosphere/min and eliminating supersaturated conditions.

The bottom of the excavated canal would be 17 feet, 6 inches wide with 1:1 side slopes. A 1.5 foot wide and one foot tall structure would separate the canal into two eight foot wide parallel sections. One section of the canal would contain cobbles and boulders, while the other section would have a smooth bottom. Water depth would be three feet with a foot of freeboard. A security fence would prevent entry to the canal and 1/8 inch galvanized steel wires would be attached to the fencing over the pool to discourage avian predation.

Approximately every 10 miles there would be resting ponds for fish, which would be a minimum of 0.33 acres in size. Water would be pumped from the river for cooling purposes at these points at the rate of 50 cfs. The water would be pumped directly into the ponds, or over a baffled spillway to remove dissolved gases. An evaporative cooling line with nozzles to reduce water temperatures would surround the pond. Wires would be strung across the pools to minimize avian predation and trees would be planted around the perimeter to provide shade.

The tunnel sections of the canal would be approximately 12 feet in diameter. The tunnel would be lined, and cobbles and boulders placed on the bottom. Lighting would be provided every 50 feet and a suspended catwalk would be present.

Elevated sections of the canal would be constructed by placing 6 or 8-foot precast concrete pipe or precast open canal sections on pre-stressed concrete beams supported by circular columns. Water in culverts may be carried under pressure.

Flexible In-reservoir Salmon Passage Tube

This alternative proposes the use of flexible conduits placed in the reservoirs for the transport of juvenile fish. As with the migratory canal, this alternative has been dropped from further consideration, but a description and review of this proposal is being provided for documentation of the rationale for eliminating it from further consideration.

The conduit would have both open, floating sections and submerged, closed sections. Fish would be introduced into a head tank at collection facilities or at the dam passage flume. A flow rate of 150 to 200 ft^3/sec would maintain a flow velocity of 3-4 ft/sec. Water within the conduit would be slightly pressurized.

Several methods to maintain flow velocities have been proposed. Pumping by pump impellers is one alternative to maintaining flows in the conduit. These impellers would be spaced at 1000 foot intervals. An alternative design would use jet pumps instead of impellers. Several possibilities for using gravity, such as sequential gravity flow and a peristaltic pump, are proposed.

A mat similar to artificial turf placed in the bottom of the conduit would provide a refuge for fish. Food would be introduced at the pump stations.

Downstream Weir

A downstream weir (or multiple weirs) would be located downstream of lower Snake dams with the objective of maintaining tailwater elevations during drawdown scenarios. This would theoretically reduce or eliminate the need for modifying stilling basins and adult collection facilities.

The concept would involve dumping rock from a barge to a height which would maintain tailwater conditions close to those existing at full pool conditions. Means to pass barge traffic and adult fish would be required, but have not been identified.

Side Channel Spillway

Side channel spillways are proposed as an alternative to the modification of existing spillways. This would be required where drawing down below existing spillway crest is proposed. The designs for these spillways are still being developed. These side channel spillways would presumably, based on an initial description, be excavated into the abutments, and would function as ungated channels encouraging the passing of smolts through the side channels.

EXISTING BIOLOGICAL RESOURCES
LOWER SNAKE RIVER

The lower Snake River projects are characterized by slack water habitats, narrow riparian communities and steep-sided upland habitats. Embayments and wetland habitat are very limited in extent. Shallow water habitats (<20 feet) are found along shorelines in the Snake River projects. Acreage figures of shallow water habitats are not readily available for the projects, with the exception of Lower Granite reservoir, and substrate compositions are not well described. Extensive aquatic plant beds do not occur in the Snake River due to the relatively steep sloping bottom and water fluctuations.

AQUATIC RESOURCES

Anadromous Fish

The Snake River system provides essential habitat for anadromous fish stocks including chinook (*Oncorhynchus tshawytscha*) and sockeye salmon (*O. nerka*), steelhead (*O. mykiss*), white sturgeon (*Acipenser transmontanus*), American shad (*Alosa sapidissima*) and Pacific lamprey (*Lampetra tridentata*). With the exception of shad, all are species native to the Columbia River system. The white sturgeon is no longer considered anadromous above Bonneville Dam as it has been landlocked by dam construction, and it will be discussed in the resident fish section.

Anadromous fish runs on the Snake River have declined precipitously. A complete review of the status and history of these runs is provided in USFWS (1993). In 1991, the Snake River sockeye salmon stocks were listed as an endangered species under the Federal Endangered Species Act (Act) (56FR 58611. Nov. 20, 1991). The Snake River spring/summer and fall chinook salmon have also exhibited a dramatic decline and were listed as threatened species under the Act (57FR 14653. April 22, 1992).

During the late 1800's, the Snake River produced in excess of 1.5 million spring/summer chinook salmon (Fulton 1968, Chapman 1986). CBFWA (1990) estimated the Salmon River, a major tributary to the Snake River, produced 39 to 45 percent of the Columbia River spring/summer chinook salmon.

The information provided below concerning fish counts at the projects should be qualified. The Corps conducts counts at the projects for the purpose of monitoring possible passage problems. The counts are not meant to be accurate population censuses for fishery management purposes. They are presented here as indicators of population levels. Several factors affect this information's accuracy in terms of a census. These include fallback of fish through the powerhouse or over the spillway (which is dependant on species, river flow and percent spill), and arbitrary dates to end the counting of one race and begin the counting of another race (i.e. spring, summer and fall chinook).

By the 1950's, the number of spring/summer chinook returning to the Snake River had declined to an average of 125,000 fish per year (Fulton 1968). From 1962 to 1970, the average count at Ice Harbor Dam was 59,000 fish (USACE 1992b). The count at Ice Harbor Dam in 1979 was 12,000 fish. Primarily due to increased hatchery production, counts during the 1980's gradually increased and peaked at about 42,000 in 1988. Counts of spring/summer chinook dropped to about 17,000 in 1991 (USACE 1992b). During the period from 1957 to 1980, redd counts of spring/summer chinook in the Snake River basin declined steadily from 13,000 in 1957 to 8,500 in 1964 to 620 in 1980. Snake River spring and summer chinook spawn in the Tucannon, Imnaha, Clearwater, Grande Ronde and Salmon River. Passage of spring and summer chinook at Ice Harbor Dam occurs from April through August 11.

Estimates of fall chinook abundance prior to the early 1900's are very sketchy. It is estimated that half of the fall chinook salmon returning to the basin above McNary Dam were bound for the Snake River (Bureau of Commercial Fisheries and Bureau of Sports Fisheries and Wildlife 1964). From 1938 to 1949, fall chinook returns to the Snake River were fairly stable, with the mean of 72,000 fish. During the 1950's, returns averaged 29,000 (Irving and Bjornn 1981). Counts at Ice Harbor Dam from 1969 to 1974 averaged 8,000 fish (ODFW/WDF 1991). Estimates of wild fall chinook salmon at Lower Granite Dam have varied from 428 adults in 1983 to 78 in 1990. During 1991, 318 wild fall chinook salmon returned to Lower

Granite (estimates from L. Lavoy letter to NMFS 12-12-91). It should be mentioned that the differences in fish counts between Ice Harbor and the Lower Granite projects indicate a fairly high percentage of adult fish are lost or spawn in this reach. Fall chinook spawning in the Snake River system occurs in October and November in the upper portion of the Lower Granite reservoir to near Hells Canyon Dam in the Snake River and in the lower reaches of major tributaries such as the lower Tucannon River (Bugert et al. 1991). Possible spawning areas also occur in the tailraces of the lower Snake River projects. In the fall of 1992, redd surveys conducted by the Service in the Lower Monumental tailrace yielded no evidence of fall chinook salmon spawning activity (Dennis Rondorf, USFWS, Pers. Comm.). Spawning was documented in the Lower Monumental tailrace during the winter of 1992-93 when fall chinook fry were found in dredge tailings from the vicinity of the juvenile bypass system outfall (NMFS 1992). There is also the possibility that fall chinook may spawn in deep water areas of the lower Snake River. This has been documented in the Mid-Columbia reach by Swan (1989). Areas within the project area also provide rearing habitat (shallow backwater areas) for subyearling fall chinook.

It is estimated that prior to non-Indian settlement of the Columbia River basin, Native Americans from the area harvested about 18 million pounds of salmon and steelhead per year (Craig and Hacker 1950). It is thought that a great portion of that harvest was fall chinook due to the natural low flow conditions present.

Records of sockeye salmon abundance in the Snake River are incomplete at best. Escapement estimates of sockeye into Redfish Lake made by the Idaho Department of Fish and Game have ranged from 4,400 in 1955 to 11 in 1961, to 335 in 1964 (NMFS 1991). In 1985, 1986, and 1987 the escapement into the lake were 12, 29 and 16, respectively. Sockeye returning to the lake in 1991 (three males, one female) were captured and spawned at Eagle Hatchery as part of the captive breeding program being operated by Idaho Department of Fish and Game. Only one male returned in 1992.

Steelhead stocks have exhibited an upward trend since the mid-1970's, primarily as a result of expanding hatchery production within the Snake River basin, although run size has been decreasing since 1989. Prior to the 1970's, population trends of Snake River steelhead were similar to those exhibited by Snake River salmon stocks. Counts of steelhead over Lower Monumental Dam since 1962 have ranged from a low of 12,200 in 1974-75 to a high of 149,400 in 1989-90. The ten year average (1981-82 to 1990-91) was 95,000 fish.

Steelhead are primarily destined for areas above the lower Snake River projects, but also spawn in tributaries of the lower Snake River from mid-March to late-May, with the greatest numbers in the Tucannon River. Other tributaries used by smaller numbers of steelhead for spawning include the Palouse River, Alpowa, Asotin and Alkali Flats Creeks and Knoxway Canyon (Schuck, WDW, Pers. Comm.).

Numbers of shad passing Ice Harbor into the lower Snake River have varied greatly, ranging from 8,206 in 1987 to 119,119 in 1989. Shad passage at Ice Harbor is typically from early June through August. In 1992, 22,298 adult shad passed Lower Granite (USACE 1992b). Little is known about shad biology and life history requirements within the Columbia and Snake River basin.

Resident Fish

Fish populations have been greatly affected by the lower Snake River's conversion from a free-flowing river to a series of impoundments. The reduced current, change in bottom substrate, lower dissolved oxygen and increased water temperatures favor warm water fish species, many of which have been introduced to the Snake River. Species composition and abundance are not greatly different between the reservoirs. The abundance of some species, however, is affected by the availability of significant free-flowing tributaries and backwater habitats within a specific reservoir.

Native resident fish species such as the bridgelip (*Catostomus columbianus*) and largescale suckers (*C.macrocheilus*), northern squawfish (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*) and chiselmouth (*Acrocheilus alutaceus*) are common in the lower Snake River projects, and are the dominant species in riverine habitats, such as the channel and tailwaters (Bennett et al. 1983). White sturgeon have been greatly reduced in numbers, and comprised less than 0.5 percent of fish collected (Bennett et al. 1983, Bennett 1991). The population was estimated at 800 fish >40 cm. in Lower Granite reservoir (Bennett et al. 1993) with lower numbers in the other reservoirs (Pacific States Marine Fisheries Commission 1992). A catch and release sport fishery occurs above Lower Granite, and a slot fishery occurs downstream. A slot fishery allows harvest of fish between a minimum and maximum size. Sturgeon are found primarily in mid to deep water habitats (Bennett et al. 1983, Bennett et al. 1991). Small numbers of rainbow trout are present, although these are probably residualized steelhead. Bull trout (*Salvelinus confluentus*) are considered to be present in the lower Snake River (WDW 1992), although it appears that numbers are very low. Bull trout present in the Tucannon River, a tributary of the lower Snake River, have been radiotracked moving downstream toward the Snake River, although contact was lost prior to entry into the Snake River (Schuck, WDW, Pers. Comm.).

Introduced species, which include the majority of the sport fish, are most abundant in shallow water habitat, particularly backwaters and embayments. Smallmouth bass (*Micropterus dolomieui*), white crappie (*Pomoxis annularis*), yellow perch (*Perca flavescens*) and channel catfish (*Ictalurus punctatus*) are the most sought-after species and provide most of the sport catch. Of minor significance are bluegill (*Lepomis macrochirus*), pumpkinseed (*L. gibbosus*), black crappie (*Pomoxis nigromaculatus*) and bullheads (*Ictalurus* spp.) Smallmouth bass, pumpkinseed and white crappie are most abundant in upriver projects, probably because these projects have not yet accumulated as much sediment in main channel and embayment habitats (Bennett et al. 1983). Carp (*Cyprinus carpio*) and channel catfish are more abundant in the downriver reservoirs. White crappie standing crop in a representative embayment, Deadman/Meadow Creek embayment in Little Goose Reservoir, was estimated at 26.7 and 33.8 kg/ha at high and low pool elevations, respectively. Biomasses in Deadman/Meadow Creek embayment for other centrarchids, such as black crappie, pumpkinseed and bluegill, were 5 kg/ha (Bennett et al. 1983).

Invertebrates

Benthic diversity in the lower Snake projects is relatively low, and is dominated by chironomids and oligochaetes. The density of other taxa such as amphipods (*Corophium*) and nematodes is low. Total biomass is highly influenced by oligochaetes and ranges from 2 g/m^2 to 20 g/m^2 in Lower Granite reservoir (Bennett et al. 1990).

Mollusc diversity has been greatly reduced by the impoundment of the Snake River, and molluscs populations are presently dominated by the introduced Asian clam (*Corbicula fluminea*). In Lower Granite reservoir, *Gonidea angulata* is the most frequently observed large bivalve. Two species of floaters, (*Anodonta kennerlyi)* and (*A. californiensis)*, federal candidates for listing as threatened and endangered species, are present. All molluscs in Lower Granite reservoir were severely impacted by the 1992 drawdown (Frest and Johannes 1992).

Densities of crayfish in the lower Snake reservoirs have not been quantified, except for limited evaluations in Lower Granite reservoir. Bennett et al. (1983) found the highest densities of crayfish at upstream sites in Lower Granite reservoir, with numbers being greater in the main channels compared to benches. Mortality during the 1992 drawdown would also indicate that large numbers of crayfish are associated with riprapped shorelines.

TERRESTRIAL RESOURCES

Habitat/Vegetation

Wetland acreage along the lower Snake River is very limited, due to the topography of the Snake River Valley. It ranges from 4 acres on Lower Granite to 87 acres on Lower Monumental. Cattails (*Typha* sp.) and bulrush (*Scirpus* spp.) are the dominant plant species in these wetlands (Table 4) (USACE 1992a).

The acreage of riparian vegetation along the Snake River projects was estimated at from 148 acres at Ice Harbor to 285 acres at Lower Granite (USACE 1992a) (Table 4). Total woody riparian vegetation was estimated at 1,006 acres by USACE (1991). This was a somewhat greater estimate because the information was derived by two studies using different cover mapping criteria at different times. The steep shorelines, adjacent railroad right-of-way and unfavorable water regimes along the Snake River have limited the amount of riparian vegetation which has developed since impoundment. Riparian vegetation is typically scrub-shrub and forest-shrub, which reflects the lack of a tall tree component in riparian communities. Russian olive (*Eleagnus angustifolia*) is the dominant tree species, but black cottonwood (*Populus trichocarpa*), black locust (*Robinia pseudo-acacia*), hackberry (*Celtis reticulata*) and white alder (*Alnus rhombifolia*) are also present. Shrubs present in the riparian zone include coyote willow (*Salix exigua*), hawthorn (*Crataegus* sp.), chokecherry (*Prunus virginiana*), currant (*Ribes* sp.), red-osier dogwood (*Cornus stolonifera*), other willows (*Salix* spp.) and false indigo (*Amorpha fruticosa*). Herbaceous plants in the riparian understory are primarily weedy species such as dotted smartweed (*Polygonum punctatum*), cocklebur (*Xanthium strumarium*), thistle (*Cirsium* spp.) and mustard (*Brassica* spp).

Table 4. Wetland and riparian habitats along lower Snake River projects (from USACE 1992a).

	HABITAT (Acres)		
	Scrub-Shrub	Forest Shrub	Emergent Wetland
<u>Project</u>			
Ice Harbor	50	98	15
Lower Monumental	126	84	87
Little Goose	123	131	9
Lower Granite	102	183	4
<u>Total</u>	401	496	115

Upland habitats historically were bluebunch wheatgrass/Idaho fescue grasslands, but these have been degraded by overgrazing and are now dominated by cheatgrass (*Bromus tectorum*). Outside of the Snake River valley, much of the existing grassland has been converted to dryland wheat.

The northwest raspberry *(Rubus nigerrimus)*, a Snake River endemic, is the only plant candidate for federal listing as a threatened and endangered species occurring along the Snake River. It typically occurs in canyons adjacent to the Snake River (Deborah Naslund, WDNR, Pers. Comm.), but could conceivably have become established in riparian areas along the Snake. Known sites of several State of Washington sensitive species occur within the hydrologic influence of the lower Snake River. These include prairie cordgrass (*Spartina pectinata)*, porcupine sedge *(Carex hystricina)*, giant helleborine *(Epipactis gigantea)* and shining flatsedge *(Cyperus rivularis)* (Washington Natural Heritage Database 1992).

Relatively few islands remain on the lower Snake River. Silcott Island, which is 124 acres in size, is connected by a causeway to the mainland, and does not support waterfowl nesting. New York Island, 48 acres in size, is the largest island which is unconnected to the mainland. The three Chief Timothy islands in Lower Granite pool and Swift Island in Little Goose pool are particularly productive islands in terms of nesting waterfowl. Ten small islands or small island complexes are present in all (Boe 1988). Several of these were constructed of dredged material. Vegetation on the islands is primarily a mix of sagebrush/rabbitbrush and bunch grasses on uplands, and willows along the shorelines. Vegetation on dredged material islands is sparse.

Approximately 6,750 acres of land are designated as Habitat Management Units on the Snake River, and managed by the Corps of Engineers under the lower Snake River Fish and Wildlife Compensation Plan. These units range in size from 1/4 acre islands to the 832 acre Big Flat Unit. Most of these units are managed as dryland units, with the primary management practice being fencing to exclude cattle. Other practices used to varying degrees include installation of nest boxes, elevated goose tubs and guzzlers. However, 764 acres are under irrigation and are intensively managed to provide a diversity of wildlife habitats, which include food plots, goose pasture, irrigated trees, shrubs, grasses and forbs, as well as native plant communities (USACE 1991).

Birds

Canada geese (*Branta canadensis*) are the most conspicuous waterfowl species along the lower Snake River. They primarily nest on islands and cliffs. Elevated goose tubs have been placed in shallow water areas throughout four reservoirs to reduce predation and are receiving increasing use. Little Goose supports the highest numbers of island-nesting Canada geese, with 90 nests recorded in 1991. In 1991, 34 nests were found on islands on Lower Granite, five nests on islands on Lower Monumental and three nests on islands on Ice Harbor (USACE 1992a). Nesting by other waterfowl species is unquantified. Other aquatic birds of interest which occur on the lower Snake River are the great blue (*Ardea herodias*) and black-crowned night heron (*Nycticorax nycticorax*) and belted kingfisher (*Megaceryle alcyon*).

Wintering waterfowl populations are highest on the Ice Harbor pool, and decline rapidly upstream (John Annear, Umatilla NWR, Pers. Comm). Mallards (*Anas platyrhyncos*) and Canada geese are the dominant species present. Peak numbers of wintering waterfowl occur during November-December, and reached an average of 37,475 individuals on Ice Harbor during 89-91. Aerial surveys are not regularly flown on projects upstream of Ice Harbor, although surveys were flown in 1992 in conjunction with the test drawdown. The greatest number, over 5,000 birds, were counted on Little Goose. These projects are used primarily for resting and are used heavily only when waterfowl densities are very high elsewhere on the Columbia River. This has not occurred in recent years.

Raptors such as the red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*) frequently nest in riparian zones along the lower Snake River, with great horned (*Bubo virginianus*) and long-eared owls (*Asio otus*) present in smaller numbers. Barn owls (*Tyto alba*) nest in adjacent cliffs, and use the riparian forest for perching (Asherin and Claar 1976). Prairie falcons (*Falco mexicanus*) also nested on cliffs in the past (Asherin and Claar 1976), but few are now known to nest along the lower Snake River (C. Christensen, USACE, Pers. Comm.). Relatively few bald eagles (*Haliaeetus leucocephalus*), approximately 10 (USACE 1992a), winter on the lower Snake River and use the riparian forest for perching and roosting.

Upland game birds along the lower Snake River include ring-necked pheasant (*Phasianus colchicus*), chukars (*Alectoris graeca*), California quail (*Lophortyx californicus*) and mourning doves (*Zenaidura macroura*). The irrigated HMU's provide excellent habitat for California quail, as do numerous vegetated drainages, but quail habitat is limited in other areas (USACE 1991). Ring-necked pheasants use riparian zones for cover, and are particularly abundant where riparian forest is associated with agricultural lands or irrigated HMU's. Lower Granite and Little Goose projects provide the best habitat for chukars (USACE 1992a), although they typically utilize upland habitats instead of irrigated HMU's. They concentrate along the Snake River when other sources of water are unavailable during summer and fall (Asherin and Claar 1976). Mourning doves are common along the lower Snake River, where they feed primarily in sagebrush and agricultural fields, but they nest and roost in riparian forests. (Asherin and Claar 1976).

A variety of birds are found on the lower Snake River, although species diversity is not particularly high. Habitat quality and areal extent limits numbers of species dependant on riparian forest, such as the downy woodpecker (*Dendrocopos pubescens*) (USACE 1991). Bird species numbers recorded at Snake River Projects ranged from 60 species at Ice Harbor to 118 on Lower Monumental/Little Goose. Higher species diversity at Lower Monumental/Ice Harbor is reflective of the amount of riparian habitat present (Asherin and Claar 1976), and greater rainfall which supports higher shrub densities on adjacent hillsides.

Mammals

The restricted acreage of riparian vegetation, steep topography and fluctuating water levels are significant factors affecting populations of mammals along the lower Snake River. Mule deer (*Odocoileus hemionus*) are the most common big game animal, and they are present in increasing numbers upstream, with highest densities present on Lower Granite and the upper half of Little Goose. Winter deer range on the HMU's is considered to be of low to moderate quality, based on a study using Habitat Evaluation Procedures (HEP) (USACE 1991). Aerial censuses conducted annually from 1978-1988 counted maximum densities of 13 deer/square mile along the lower Snake River and associated tributaries in the winter of 1988. Mule and white-tailed deer (*Odocoileus virginianus*) comprised 80 percent and 20 percent of the numbers respectively (USACE 1990). Deer use of the lower Snake River is greatest during winter months, when they use side canyons and riparian zones.

Aquatic furbearers present along the lower Snake River projects include river otter (*Lutra canadensis*), mink (*Mustela vison*), muskrat (*Ondatra zibethica*) and beaver (*Castor canadensis*), although they are not abundant. A Habitat Suitability Index calculated for river otters indicated that habitat quality was moderate, with denning sites being limiting (USACE 1991). The scarcity of riparian and emergent vegetation, lack of embayments and sloughs, and fluctuating water levels also limit the quality of habitat available for aquatic furbearers (Asherin and Claar 1976). Riparian vegetation provides foraging habitat and den sites for terrestrial furbearers such as striped skunks (*Mephitis mephitis*) and raccoon (*Procyon lotor*). Bobcats (*Lynx rufus*) also tend to forage in riparian zones during the winter (Bodurtha 1992).

Other mammals occurring on the lower Snake River projects include a number of small mammals, such as deer (*Peromyscus maniculatus*) and western harvest mice (*Reithrodonotomys megalotis*), long-tailed (*Microtus longicaudus*) and mountain vole (*Microtus montanus*), northern pocket gopher (*Thomomys talpoides*) and the vagrant shrew (*Sorex vagrans*). Porcupines (*Erethizon dorsatum*) are found in riparian vegetation and yellow-bellied marmots (*Marmota flaviventris*) are found in riprap and along shorelines (Asherin and Claar 1976).

Amphibians/Reptiles

Conditions for amphibians are not particularly favorable because of fluctuating water levels and lack of wetland habitat which limits breeding. The species occurring in the greatest abundance are the bullfrog (*Rana catesbiana*), western toad (*Bufo boreas*) and great basin spadefoot toad (*Scaphiopus intermontanus*). Pacific tree frog (*Hyla regilla*) and spotted frog (*Rana pretiosa*) have also been documented as occurring on the Snake River (Asherin and Claar 1976). Of greatest interest is the spotted frog, a federal candidate threatened and endangered species.

A variety of lizards and snakes are present along the lower Snake River. However, most reptiles are associated with xeric habitats.

COLUMBIA RIVER

TERRESTRIAL RESOURCES

Only fish and wildlife habitat and resources potentially affected by the alignment of the migratory canal adjacent to the Columbia River will be discussed here.

Quality of habitat adjacent to the Columbia River varies greatly. Along John Day and McNary projects, large tracts of significant wildlife habitat occur. However, railroad and highway development adjacent to The Dalles and Bonneville projects has fragmented and reduced habitat, and limits wildlife access. Because the vegetation zone transitions from shrub steppe to oak-ponderosa pine to Douglas fir forest along the Columbia River, a great variety of habitat types are present.

Wetland acreages associated with the projects are summarized in Table 5. Emergent wetlands are typically characterized by cattails, sedges, rushes and willows. Riparian habitat has developed along much of the project, particularly at river mouths and along backwater and shallow water areas on McNary and John Day projects. Three types of riparian vegetation are found along the lower Columbia River. Riparian hardwoods are characterized by Russian olive, willows, cottonwoods and red and white alder. The riparian shrub type is dominated by willows and false indigo. A variety of rank herbs and forbs characterize the riparian herb type.

Table 5. Wetland and riparian types along the lower Columbia River projects (from USACE (1992a)).

	Habitat (Acres)				
	Riparian Shrub	Riparian Hardwood	Riparian Herb	Emergent Wetland	Other
Project					
Bonneville		1,089*		15	
The Dalles	299				78
John Day	867	361		419	
McNary	611	1,349	948	1,010	
Total	1,777	2,799	948	1,444	

**Includes riparian shrub*

Upland habitat along John Day, McNary and The Dalles projects is typically dominated by big sagebrush, bitterbrush and rabbitbrush. Cheatgrass and Sandberg's bluegrass are the dominant grass species. The forbs present are dependant on the level of disturbance of a site, with exotic weeds such as knapweed, Russian thistle, and tumblemustard predominating on disturbed sites and native species being more abundant on less impacted sites.

Downriver from The Dalles, an open forest with a tree component of Oregon white oak, Douglas fir and ponderosa pine is present. The shrub understory consists of poison oak (*Rhus radicans*), snowberry (*Symphoricarpos albus*), tall Oregon grape (*Berberis aquifolium*) and nootka rose (*Rosa nutkana*). A variety of forbs are present. Between Bonneville and Hood River, vegetation is within the Douglas fir/western Hemlock (*Tsuga heterophylla*) forest zone. Dense forest, dominated by Douglas fir, western hemlock and bigleaf maple (*Acer macrophyllum*) characterizes this zone.

Wildlife species occurring along the Columbia River upstream of The Dalles are very similar to the wildlife along the Snake River. Because of the greater extent of riparian and wetland habitat, however, densities of many species may be greater along the Columbia River.

Downstream of The Dalles, forested habitats become more prevalent. Wintering bald eagles and ospreys (*Pandion haliaetus*) are common along the river. Ruffed grouse (*Bonasa umbellus*) are found in riparian areas, but other game birds are scarce. Furbearers are common in the Bonneville Pool where riparian forests are adjacent to the river. Black-tailed deer are present where highways and railroads are not immediately adjacent to the river. Diversity of nongame wildlife species is high.

FISH AND WILDLIFE UTILIZATION

Limited data for fishing and hunting are available for the lower Snake River projects. Fishing for a variety of species occurs, with bass, crappie and channel catfish being the primary warm water species sought (Bennett et al. 1983). Steelhead are harvested in significant numbers, with harvests over 10,000 fish in good years in the 4 reservoirs. Fishing activity is greatest on Lower Granite, which had an estimated 289,223 angler-days in 1991 (USACE, Unpub. data). Ice Harbor also receives heavy use with Little Goose and Lower Monumental experiencing significantly less pressure.

Hunting on project lands is primarily for upland game birds. Hunting for deer also occurs. Lower Granite receives the most hunting use, with 9,313 hunter days recorded in 1991. The level of hunting on private lands is unknown. Wildlife viewing is also popular, and is undoubtedly a significant activity for visitors to project lands.

BIOLOGICAL RESOURCES-FUTURE WITHOUT THE PROJECT

The lower Snake Projects are operated as run-of-river projects with a 3-foot operating range on Ice Harbor and Lower Monumental projects and a 5-foot operating range on Little Goose and Lower Granite Projects. A 2-foot daily fluctuation is normal, with reservoirs filling at night and being drawn down during the day. It should be emphasized, however, that project operation has changed over the years, and varies from year to year, depending on the water year, and there is much debate over how the base case should be defined.

Predicting the future without the project requires some assumptions as to what future operations would be. Three base case scenarios were identified for comparison to the drawdown alternatives. These include: 1) 1991/92 Operations, 2) Operations under the 1984-90 Water Budget, and 3) Pre-Water Budget Operation with lower Snake River at Maximum Pool. It is assumed for this analysis, however, that the future interim operations would be dictated by endangered species considerations for the Snake River sockeye and chinook salmon, and that reversion to pre-1991 operations is highly unlikely. Future operations would therefore most closely resemble 1991-1992 and proposed 1992-1993 operations. This operational scenario would affect biological resources in different ways from historical operations, and may result in both short and long-term changes in fish and wildlife populations.

AQUATIC RESOURCES

Anadromous Fish

It would be expected that Snake River salmonid populations, particularly wild stocks, would continue to decline under a no-project scenario. Delayed juvenile outmigration and mortality at the dams and in the reservoirs would continue. Adult upstream migration would also continue to be delayed.

The migration travel time for Snake River anadromous salmonid juveniles has increased significantly since historic conditions due to the formation of slack water habitat in the four reservoirs of the lower Snake River. Prior to dam construction, it took smolts about 22 days to travel from the Salmon River in Idaho to the lower Columbia River (Ebel 1977). The smolt travel time now from the Salmon River can take over 50 days (Ebel 1977). This protracted migration time has decreased juvenile salmonid survival.

As smolts migrate, they continue to undergo physiological changes in preparation for a transition to the marine environment. The physiological, morphological and behavioral changes which occur during the smoltification process prior to and during migration evolved under conditions when seasonal increase in runoff provided for rapid migration. The increased travel times therefore reduce the chances that migrating juvenile salmon will arrive at saltwater within the proper time frame. The additional migration time increases the exposure of smolts to disease and predator challenges, which decreases their chances of survival.

The four projects in this section of the Snake River also delay adult salmonid passage, which affects survival and subsequent spawning success. Bjornn et al. (1992) found that during a 1991 radio-tagging study to evaluate adult fish passage at the four lower Snake River projects, the mean passage time through the dams for spring and summer chinook was 7.9, 2.2, 1.8 and 3.1 days for Ice Harbor, Lower Monumental, Little Goose and Lower Granite, respectively. Some of the delay at Ice Harbor and Lower Granite was attributed to the presence of traps for sampling adult salmonids in the ladders of the two projects. Bjornn et al. (1992) also found the average time of passage through the four reservoirs (not including the time to pass through the dams) was 1.8 days per reservoir and the average speed was 55 km. per day for spring/summer chinook moving up into the Clearwater River, and average passage time was 1.4 days per reservoir (not including the time to pass through the dams) and the average speed was 58 km. per day for spring/summer chinook moving up the Snake River. The actual mean time for spring/summer chinook to migrate from the tailrace of Ice Harbor Dam to the forebay of Lower Granite was 20.8 days (11.6 km./day). This work is ongoing in 1993 and results are still considered preliminary and subject to revision.

In a literature review, Bjornn and Peery (1992) determined that, prior to impoundment, chinook salmon migrated upstream through the lower Snake River and its tributaries at rates of 20-24 km/day during the spring and summer. Bjornn and Peery (1992) also determined that prior to impoundment steelhead migrated at rates of 10-16 km/day when actively migrating in the spring, summer and early fall, while there was almost no movement during the late fall and winter. They concluded that adult salmonids passed through the Snake River reservoirs at similar or faster rates than the unimpounded river. In addition to delay of adult passage, there is evidence from the fish count information that a large percentage of adult salmonids do not pass all four projects and are lost or spawn in this reach.

A modeling estimate of the effects of the 1993 SEIS no-action alternative on chinook salmon, which is assumed to be comparable to a future without the project, was derived using the State Fisheries Agencies and Tribes Empirical Life Cycle Model and Fish Leaving Under Several Hypotheses Model. The results showed continued declines in escapement for spring/summer chinook and fall chinook. These models, their assumptions, and the results are described in USFWS (1993).

Resident Fish

Resident fish populations have been limited in the past by historical operations. Fluctuating water levels have affected spawning success, habitat quality in shallow water and embayments, and food abundance. Annual repetition of the 1992 operations may have both positive and negative effects. A reduction to MOP during the fish outmigration would reduce the backwater habitat available for spawning and rearing, and would eliminate food production at elevations within the normal operating range. However, stabilized water levels at MOP during the spawning season in 1991 appear to have resulted in improved spawning success and recruitment (Bennett 1991). Stabilized water levels may also increase macrophyte abundance and nearshore benthic production. In 1992, the deviations from MOP which occurred were sufficient to impair reproductive success (D. Bennett, Pers. Comm).

TERRESTRIAL RESOURCES

An idea of the effects of the operation of all the projects within one foot of MOP can be derived from observations made during 1992 operations. The first year of vegetation monitoring indicates that significant revegetation of the present operating zone is occurring. Revegetation has primarily been by a wide diversity of annual forbs, sedges and shrubs such as willows, false indigo and alder at riparian sites, and bulrush, cattails and reed canary grass on mudflats adjacent to wetlands (Cushing 1993). Species composition appears to largely reflect substrate and nearby vegetation (Pers. Observ). Continuation of this operational scenario may permit this successional process to continue, which would have benefits for riparian and wetland wildlife. A word of caution is that the water levels in 1992 were not always held within one foot of MOP as planned, but were occasionally raised. This provided water to vegetation in the operational zone, and probably enhanced plant growth.

Some negative effects to wildlife may result from operation at MOP. Where managed goose pastures are present, slight increases in predation on goose broods may occur because the distance between foraging areas and open water would be increased. Predator access to some islands used by nesting waterfowl may also be enhanced. Dens and lodges that are established by beaver and otter during the low water period would be flooded when the pools are raised again in late summer/fall.

Without the project, management of the HMU's would result in continuing improvement of shrub and riparian forest quality on irrigated sites (USFWS 1991). This should benefit mule deer, California quail, many songbirds and other target species. Acquisition and development of additional HMU's under the Lower Snake River Compensation Plan is also underway, and will result in higher quality wildlife habitat along the lower Snake River.

In summary, under existing conditions, wildlife habitat quality on HMU's should continue to improve as vegetation plantings mature. For unmanaged wetland and riparian habitats, conditions would remain the same, or slightly improve with reduced fluctuations and operation at MOP.

BIOLOGICAL RESOURCES-FUTURE WITH PROJECT DRAWDOWN ALTERNATIVES

AQUATIC RESOURCES

Anadromous Fish

A crude estimate of the effects of the alternatives can be derived by comparing water particle travel times under different alternatives. Reducing the cross-sectional areas of the reservoirs through a drawdown would decrease water particle travel time, and thereby increase the migration rate of juvenile salmonids. The amount of decrease in travel time would depend on the level of drawdown and the time period when the drawdown occurs. The natural river option would theoretically provide water particle travel times similar to the historical condition and would also provide the most significant benefits to downstream migrants.

An analysis of water travel time at river discharges of 25,000 and 160,000 was performed (USACE 1992c). Under low flow conditions, the natural river alternative provides a 92% reduction in water travel time from travel time that would be expected at minimum operating pool. Other alternatives provide reductions of 50-70% in water travel time. At high flows, the natural river alternative provides a 78% reduction in water travel time, while other alternatives provide reductions of 40-59% in water travel time.

Table 6. Projected water travel time through the lower Snake River projects under drawdown alternatives (Adapted from USACE 1992c).

ALTERNATIVE	River Discharge 25,000 cfs		River Discharge 160,000 cfs	
	Total Hours	In Pool Time*	Total Hours	In Pool Time
Normal Max Pool	820	820	130	130
Normal Min Pool	761	761	121	121
Alt. 4A	62	0	27	0
Alt. 5/9	229	211	60	51
Alt. 13/17	379	372	72	59
Alt. 14/18	293	283	59	54
Alt. 15/19	231	215	50	42

*Reservoir pools still exist with all alternatives except the natural river (4A) option. The number of hours spent within the remaining pools is shown under In-Pool Time.

The influence of flows and smoltification on travel time has been more closely studied in Lower Granite reservoir. During 1989, 1990 and 1991, Service biologists studied the relationships between river flow, travel time and smoltification of juvenile spring chinook as they migrated through a 52 km. reach of Lower Granite reservoir. Juvenile spring chinook in 27 release groups were tagged with Passive Integrated Transponder (PIT) by the Idaho Department of Fish and Game at the Snake River trap at Lewiston and released daily. PIT tags are surgically implanted in the body cavity, and are activated by an external energy source which is also capable of reading the response from the tag. This response identifies information implanted at the time of tagging. Information includes date and time of release, release location, fish size, and other biological data. The PIT-tagged fish were detected as they passed Lower Granite Dam, and median travel times were estimated for each release date. Smoltification was assessed by measuring levels of gill Na^{+}-K^{+} (ATPase) from ten groups of ten fish sacrificed biweekly during 1989 and 1990 and 3 times per week in 1991.

From these studies, a regression equation to predict travel time was developed based on the flow-velocity relation at a forebay elevation of 733 fmsl at Lower Granite Dam, and gill ATPase activity of the fish at the Snake River trap. Velocity estimates were calculated by dividing distance from the Snake River trap to Lower Granite Dam (52 km) by the average water travel time in this reach. Average water travel times were provided by the U.S. Army Corps of Engineers (David Reese, U.S. Army Corps of Engineers, Walla Walla District).

The potential effects of different reservoir drawdowns was estimated after regressing travel time on ATPase activity and water velocity. The equation, based on N = 27 release groups and having an R^2 = 0.56, is:

$$\ln TRAV = 4.024 - 0.963 * \ln ATPase - 0.548 * \ln VELOCITY$$

where: lnTRAV = natural log of travel time in days

lnATPase = natural log of gill ATPase activity in μ moles $P_i * mg\ Prot^{-1} * h^{-1}$

lnVELOCITY = natural log of water velocity in meters/second

The predicted effects of 33, 43 and 52-foot drawdowns on reservoir volume, water travel time and juvenile spring chinook travel time from the IDFG Snake River trap to Lower Granite Dam are presented in Table 7. A drawdown from 733 fmsl to 700 fmsl (33 ft) would decrease water particle travel time by 51%, resulting in a decrease in spring chinook travel time of 32%. A 43-foot drawdown to 690 fmsl, and a 52 ft. drawdown to 981 fmsl would reduce water particle travel times by 62% and 70%, respectively, and result in reductions in spring chinook travel times of 41% and 48%, respectively. The percent change reflects an equally weighted average of separate simulations of flows ranging from 20 kcfs to 120 kcfs in 10 kcfs increments (John Beeman, USFWS, Pers. Comm.). A similar analysis is not available for other projects or drawdown alternatives.

Table 7. Predicted effects of several drawdown alternatives of Lower Granite reservoir downstream from the IDFG Snake River trap, based on averages at flows from 20 kcfs to 120 kcfs at proposed pool elevation for constant pool alternatives. Changes are expressed as a percentage of minimum operating pool (MOP).

Forebay elevation (fmsl)	Reservoir volume (Acre-feet	Change in volume	Change in water travel time	Change in fish travel time
733 (MOP)	427,572	----	----	----
700	219,832	-48%	-51%	-32%
690	173,399	-59%	-62%	-41%
681	139,585	-67%	-70%	-48%

Barge transportation of juvenile salmonids from the lower Snake River project would not be feasible under the drawdown alternatives because of navigation interruptions. Truck transport would be feasible. However, during peak migration periods, equipment limitations may affect this operation.

Transportation benefits, if they exist, would be potentially replaced under the drawdown alternatives with benefits from improvements in migration conditions and decreases in fish travel time. The tradeoff between the benefits from transportation under certain flow conditions and drawdown would vary by species and season, the length of the drawdown period (2 months or 4.5 months) and the amount of drawdown in each reservoir.

The variable pool and constant pool drawdown alternatives call for modifications to the existing juvenile and adult fish passage facilities. In some cases, the use of new, unproven technology would be required. In cases of extending current technology, the period of research may be protracted. This has been the case with the submersible traveling screen technology that has been under development for over two decades. (Matthews et al. 1977; Park et al. 1976; Swan et al. 1985). Due to facility modifications, survival rate increases caused by decreases in travel time may be offset by increases in juvenile mortality caused by new or modified juvenile bypass facilities, changes in fish guidance efficiencies (ability to guide fish away from the turbine intakes into the bypass system) and water quality conditions due to increased spill at the modified projects. Changes to the adult fishways at the modified projects may cause added delay and subsequent lower survival and spawner success.

The current juvenile bypass systems do not function at all when water levels are three or four feet below minimum operating pool. Installation of a collector to accommodate juvenile passage as the reservoirs are drafted would be subject to structural and hydraulic constraints and concerns.

The use of pressurized juvenile collection channels associated with the variable pool alternatives is a major concern. The use of pressurized systems in existing juvenile bypass systems has been avoided due to stress and injury to fish. Among the concerns is the potential injury or death of fish which occurs in the proximity of entrained air. The current agency and tribal policy is to avoid pressurized systems due to unacceptable impacts to fish.

The existing vertical barrier screens were designed to operate within certain water elevations. Drafting of the reservoirs would reduce the effective surface area of the vertical screens and would create adverse hydraulic conditions for juvenile salmonids in the gatewell. Complete redesigns of the vertical barrier screens and submerged traveling screens may be required, with accompanying biological evaluation. This biological evaluation is necessary to assess fish guidance effectiveness, orifice passage, fish impingement and overall bypass collection efficiency. Fish guidance efficiency would also be affected by the lowered forebay elevation, which would change the vertical distribution of juveniles approaching the powerhouse, and the angle and area of interception, which influences the number of fish guided.

The efficiency of adult passage facilities may also be affected. Concerns for adult passage under all constant and variable pool drawdown alternatives include the effect of low tailwater elevations on the adult collection facilities, effects to the adult collection systems from low powerhouse discharge in conjunction with high spill, and the use of ungated spill through the existing spillway which would prevent the establishment of crowned spill patterns needed to provide adequate adult passage conditions. The possibility of increased fallback of adults is another concern that should be addressed.

The drafting and refilling of the reservoirs would have serious effects on fish passage, with the natural river option interrupting passage to the greatest extent. Due to restrictions on drafting (limited to 2 feet per day) a five to six week period would be needed to completely draw down the reservoir to the natural river levels. Once at this level, fish passage would occur through the bypass structure. Recent testing by the Corps of Engineers of a physical model of Lower Granite project incorporating the preliminary design for the bypass structure indicates that water velocities would meet adult fish passage criteria and allow passage of juvenile fish within accepted passage criteria only at flows of 60 kcfs or lower. The Corps has acknowledged that the structure would be changed to meet the appropriate passage criteria. After the designated drawdown period (either two or four and one-half months), fish passage would again be impacted while the reservoirs refill. Estimates of refill are from several days to over 90 days, depending on natural river flow and flow augmentation.

Drawdown may affect access for spawning wild steelhead and spring chinook to certain tributaries of the lower Snake River because of the large silt deltas which have developed at the mouth of these streams. Until the stream bed cuts a channel through the silt to the new river elevation during drawdown, a drop from the top of the delta to the river may be present. This may block access to streams. Access to larger streams, such as the Tucannon River, would be easiest for steelhead, which migrate up into the river during much of the winter. For smaller streams steelhead do not hold in the streams and they typically move up into the stream only during spawning, which coincides with the drawdown period.

Although the present significance of the lower Snake River projects for anadromous fish is as a migration corridor, they historically provided rearing habitat for fall chinook and rainbow trout/steelhead. The significance of this rearing habitat at present is not well established, but is believed to be limited. Its value would be lost during drawdown. There is also the potential for stranding of juvenile salmonids during drawdown. Lamprey ammocoetes may also be stranded, as occurred during the 1992 test drawdown.

Resident Fish

The 1992 test drawdown of Lower Granite, carried out in March, 1992, provided a demonstration of the direct impacts which the drawdown alternatives would have on resident fish. The drawdown stranded and killed thousands of fish, although the vast majority of the mortality was young-of-the-year fish, particularly bullheads. To apply the proper perspective, however, a bullhead produces from 2,000 to 13,000 eggs, a northern squawfish produces 6,700-83,000 eggs and a smallmouth bass produces 5,000 to 20,825 eggs (Wydoski and Whitney 1979). Estimates of dead fish ranged from 15,000 (Schuck 1992) to 35,000 (Schiewe 1992). The larger estimate was assumed to be a result of more intensive coverage by National Marine Fisheries Service personnel (Wik 1992). Of the estimated 15,000 dead fish, brown bullhead and crappie respectively made up 67 percent and 13 percent of the total. Other species stranded included smallmouth and largemouth bass, bluegill, pumpkinseed, northern squawfish, carp and redside shiners, as well as a very limited number of steelhead. Stranding of white sturgeon was not observed. Most of the fish were stranded within the first 10 days of the drawdown, at which time the pool was drawn down 23 feet. It would therefore appear that direct mortality from stranding, at least in Lower Granite, would be similar under all drawdown alternatives.

Several points should be made about mortality during the test drawdown. Most importantly, the number of fish lost was probably insignificant relative to the number of fish present in the reservoir (Cochnauer, IDFG, Pers. Comm.). In addition, the majority of fish killed were bullheads, an exotic species with little recreational value. Many of the remaining fish killed were juvenile crappie, and the one-time loss of these fish is not likely to the impact crappie populations in the reservoir (Cochnauer, IDFG, Pers. Comm.). Adult smallmouth bass numbers were similar before and after the drawdown, but it appeared that smaller bass, primarily age-1 fish, were significantly less abundant after the drawdown (D. Bennett, Idaho Cooperative Fish and Wildlife Research Unit, Pers. Comm.). Largemouth bass were the species believed to be most significantly affected (Schuck 1992). Obviously, however, the cumulative effects of stranding from annual drawdowns would be more severe.

Spawning and rearing for resident fish would be greatly affected by drawdown alternatives. The centrarchid species are all dependant on embayment and other shallow water habitat for spawning (Bennett et al. 1983). All existing habitat of this type would be dewatered during the spawning season, which starts with smallmouth bass spawning in April and continues through the end of crappie spawning in August. Young fish are also heavily dependant on shallow water habitat (Bennett et al. 1983, Schuck 1992). New shallow water habitat would be created by the drawdown, and availability of shallow water habitat would actually increase at Ice Harbor and Lower Monumental (USACE 1992a). Under the variable pool alternatives, however, water fluctuations would limit any potential value of the newly-created shallow water.

Substrates in these new shallow areas would mostly be fines and silt, and not the gravels and sands preferred for spawning by warm water species (Bennett et al. 1983). It is also likely that hydrological characteristics such as water velocity would not be as favorable for lacustrine species under drawdown conditions. Lower water temperatures predicted by modeling under drawdown conditions (USACE 1992) may retard spawning initiation. These impacts would probably result in a fish community similar to that found in the Mid-Columbia River, which is dominated by non-game fish (Bennett 1991).

Macrophytes would essentially be eliminated within any drawdown zone. These plants provide food and cover for a variety of resident fish, particularly yellow perch, juvenile pumpkinseed, bluegill, largemouth bass, crappie, bullhead and bridgelip suckers. Yellow perch would be the species most significantly affected, as they were the only resident fish species found to be positively correlated with macrophyte abundance. This can be attributed to their use of rooted macrophytes for spawning (Bennett et al. 1983).

The forage base for resident fish would be significantly reduced. Schuck (1992) estimated that tens of thousands of crayfish, which are the most preferred smallmouth bass food item in the lower Snake River (Bennett et al. 1983), died during drawdown. Crayfish are also very important in channel catfish and sturgeon diet. The most significant effect to the forage base for fish would be the effects to chironomids, since chironomids form a dietary component of moderate importance for most resident fish. Zooplankton production would be expected to decline under the drawdown scenario because of decreased water retention times. This would most directly affect crappies and redside shiners, for which cladocerans are the dominant food items (Bennett et al. 1983).

Downstream displacement of adult fish may also occur during drawdown as fish species such as smallmouth bass become more concentrated. If fish populations are at carrying capacity, increased competition would be expected under drawdown conditions. The loss of preferred habitats such as riprap would also tend to increase competition for remaining cover.

Impacts to native non-salmonid resident fish species would probably not be great as for exotic species. Most native species are broadcast spawners, preferring the flowing water which would be present during drawdown conditions, and are not highly dependant on clean gravel. White sturgeon, the species of greatest concern, would probably not be greatly affected (Tim Cochnauer, IDFG, Pers. Comm.). The natural river option may also permit white sturgeon to pass between reservoirs, which may be beneficial in terms of maintaining genetic heterozygosity of white sturgeon populations along the Snake River. There may be some negative effects, however, because of the reduced food availability in the reservoirs. Stranding of some species during drawdown would also be a problem.

The drawdown alternatives would increase turbidity, particularly during the initial years, as years of accumulated sediment would be eroded by river flows. Turbidity may result in reduced spawning success and reduced prey availability and feeding success and consequently, smaller resident fish populations and lower growth rates. Turbidity in the range of 100-200 mg/l may be expected to result in some mortality of sensitive species such as trout and whitefish (USACE 1992a), which are found in low numbers on the Snake River. The worst case scenario for increases in turbidity on the Snake River predicts 200 mg/l for 30 days with a drawdown to spillway crest (USACE 1992a). Plankton production may also be reduced by increased turbidity. It would be likely that turbidity would decrease, however, as soon as a new equilibrium was reached between the new flow regime and sediment deposition.

The drawdown alternatives with the new modified spillways may result in some increase in the level of gas supersaturation, depending on the level of spill and effectiveness of gas dissipation structures. Under the natural river option, gas supersaturation should not be excessive. Should gas supersaturation reach levels of 115 percent - 125 percent, effects to resident fish may be expected. However, if gas supersaturation is present, resident fish would probably tend to avoid the area.

Invertebrates

Benthic invertebrate densities in the drawdown zone would likely be reduced with the drawdown alternatives, as benthic organisms do not tolerate prolonged desiccation. Recolonization after refill would occur to some extent, dependant on duration and depth of dewatering, and would likely be greater in the upper pools where benthic drift from free-flowing stretches of the Snake River enters the lower Snake River projects. Recolonization by chironomids is likely to be most rapid because of their short life cycle and mobility of the adults.

Elimination of the mollusc fauna would be expected within the drawdown zone. Certain species, which are already rare, such as the floaters, would probably be eliminated. The Asian clam, which is presently abundant and is an important white sturgeon food item, is likely to be substantially reduced (Bennett 1991).

Crayfish numbers would be greatly reduced by the drawdown alternatives. Based on observations during the 1992 drawdown, crayfish are very susceptible to stranding mortality because they seek refuge in nearby cover, such as riprap, rather than following the receding water line.

TERRESTRIAL RESOURCES

All of the proposed alternatives involving drawdowns would have negative impacts on wildlife, although effects would vary depending on drawdown level and duration. Reductions in wildlife populations may occur through direct mortality or indirectly, through habitat loss and degradation.

Land Bridging of Islands - Direct mortality may occur by allowing predator access to islands during the peak of the Canada goose nesting season, although if drafting is initiated in the proposed February/March time frame, nesting on islands may be discouraged completely. Predator access to islands increases rapidly if the water depth is less than 1.5 feet, and is also affected by channel width and water velocity (Bruce Zoellich, USFWS, unpublished data). The effects range from potential landbridging at MOP of one nesting island at Lower Granite, and two each at Ice Harbor, Little Goose and Lower Monumental (USACE 1992a), to land bridging of all islands with the natural river option.

Creation of Drawdown Zone - The drawdown zone would have two effects on wildlife. It would create a large unvegetated area between the riparian/upland vegetation and the water, and would expose habitats normally covered with water.

This drawdown zone would be a barrier for species moving between terrestrial and aquatic habitat. Goose broods would have to traverse large expanses of dewatered shoreline to access foraging areas, during which time they would be vulnerable to predation. Game birds, such as ring-necked pheasants and California quail, which use the Snake as a water source during mid to late summer may experience increased mortality from predation while crossing the drawdown zone. Deer fawns might be subject to increased coyote predation if they traverse the drawdown zone to water. Aquatic furbearer access to riparian/mesic vegetation may be impaired by the drawdown zone. The ravines that cut through silt deposits in side canyons would make access to these important sites more difficult for furbearers.

The test drawdown at Lower Granite in 1992 demonstrated the magnitude of the reduction in biological production that would occur in the drawdown zone. Of obvious concern is the stranding mortality of large numbers of molluscs and crayfish. Besides the fact that these organisms are of significance to the biological diversity of the aquatic ecosystem, they also are an important food source for otter and mink (Tabor et al. 1981). Submerged vegetation would also be eliminated within a drawdown zone. This would have the greatest effect on diving ducks, wigeon and coots, which feed primarily on aquatic plants such as *Potamogeton* and *Elodea*. Aquatic plants can also be a locally important food source for Canada goose broods (Tabor et al. 1981). Effects of the drawdown on resident fish populations would affect piscivorous birds such as wintering bald eagles, herons, common mergansers (*Mergus merganser*) and belted kingfisher.

Drawdowns would also expose muskrat and beaver dens and the young in particular would be vulnerable to predation. Entrances to otter dens, which are preferentially located in rock outcrops and rock piles, may also be exposed or filled with silt during drawdown (Kronneman, Nez Perce Tribe, Pers. Comm.)

Potential benefits to wildlife are limited to increased nesting and foraging habitat for breeding and migrant shorebirds, and the short-term increase in food availability for piscivorous birds resulting from stranding of fish.

Dewatering of Riparian and Wetland Habitat - Indirect impacts to wildlife resulting from potential habitat degradation and loss, and resultant loss of food and cover resources, may occur. Degradation and loss of riparian and wetland vegetation would have profound effects on the 65 vertebrate species dependant on riparian habitats along the Snake River (Lewke and Buss 1977).

The effect of a 2-month drawdown from mid-April to mid-June on riparian and wetland vegetation is difficult to predict, but at a minimum, the species composition of vegetation is likely to be altered. Effects on regeneration would be species specific, depending on the phenology of a species, and regeneration of some species would not occur. Growth would be affected as riparian and wetland vegetation is particularly sensitive to moisture loss during the growing season, and species adapted to more xeric conditions would become more prevalent. In general, early successional exotic species would become more predominant.

The 4.5 month drawdown would have a more predictable and dramatically greater effect because the drawdown would continue into the hottest period of the summer. Large-scale mortality of riparian trees and shrubs would be expected and regeneration would not occur, although the drawdown's abnormal hydrological pattern adds an element of uncertainty to this prediction.

Site characteristics and plant species requirements would be a factor in what would happen on a site. Riparian vegetation on shallow soils would be more vulnerable to drought effects from a drawdown than vegetation on deep soils (Walters et al. 1980). Species such as cottonwood and willow, which have shallow root systems (Arno and Hammerly 1977), are also more vulnerable to drought than deeper rooted species, such as Russian olive and hackberry (Walters et al. 1980). Russian olive can grow in areas with 8" of precipitation (WSU Coop. Exten. 1983) and would be expected to persist if already established. Black locust and Russian olive are considered to be suitable for planting in the 12-15" rainfall zone, which is typical of rainfall on the upstream lower Snake River projects. These exotic species are not as desirable from a wildlife standpoint as native species such as cottonwood and willow, which have greater moisture requirements and would be less likely to persist. There might also be some small differences in vegetation response due to rainfall. Ice Harbor and Lower Monumental receive less that 10 inches of rain annually, while rainfall at Lower Granite Dam is 19 inches.

All of the State of Washington sensitive plant species known to occur along the Snake River, which includes prairie cordgrass, porcupine sedge, giant helleborine and shining flatsedge, are hydrophytic. Soil moisture under the drawdown alternatives would most likely be inadequate to continue to maintain these plants.

Within the drawdown zone, some growth of herbaceous plants would be expected, although it would probably be limited to a strip within the hydrologic influence of the river at drawdown. Based on observations during the 1992 growing season (Battelle 1992), it would be expected that plants colonizing this zone would be mostly weedy annual species such as cocklebur, speedwell, horehound horseweed and smartweeds. These would provide some wildlife value where species such as smartweed were flooded with shallow water in the fall and could be utilized by waterfowl.

The values of riparian vegetation for mule deer which include winter thermal cover and summer shade would be reduced or eliminated. Plant species such as willow, which is an important fall and winter deer browse (Tabor et al. 1981), would be eliminated.

The effect on furbearers of a change in riparian and wetland vegetation is likely to be severe. All furbearers are dependant on riparian and wetland vegetation for food and cover. Beavers and muskrats obtain materials for lodge construction from riparian zones and wetlands. Cottonwood and willow, which are preferred beaver food, would be the first woody species to disappear. Mink are dependant on riparian zones for foraging, where they capture large numbers of rodents (Tabor et al. 1981).

The loss or degradation of riparian and wetland vegetation would affect a wide variety of bird species. Cover used by pheasants and California quail would be lost. Raptors using perch sites in the riparian zone might receive some short-term benefits as more snags were created, but the long-term impact would be negative as perch trees would not be replaced. Nesting habitat for a number of raptors would also be lost. Nongame bird species, particularly neotropical migrants such as yellow warbler (*Dendroica petechia*), northern oriole (*Icterus galbula*), black-headed grosbeak (*Pheucticus melanocephalus*) and lazuli bunting (*Passerina amoena*) are obligate riparian nesters (Tabor et al. 1981) in arid areas, and would disappear if the riparian zone was lost.

<u>Habitat Management Units</u> - Irrigation of Habitat Management Units would be greatly affected as the existing pumping stations are designed to operate at existing pool levels. If irrigation is terminated, significant mortality of tree and shrub plantings could be expected. The factors which would affect species-specific mortality have previously been discussed under drawdown effects on riparian vegetation.

Without irrigation, there is also a high probability, given the high fuel load and proximity of the railroad to most of these sites, that any surviving trees and shrubs would at some point be destroyed by wildfire. The impacted species would be similar to those affected by loss of riparian habitat. Without irrigation, cereal grain and food plot plantings would have to be terminated. This would mostly affect game species, particularly upland game birds and mule deer, which exploit these food resources.

Based on the HEP evaluation, Habitat Management Units currently contribute 26% of the Habitat Units under current habitat conditions (USACE 1991). Most of this habitat value would be lost should irrigation be terminated.

<u>Excavation and Disposal of Material for Natural River Bypass Structure</u> - Construction of the bypass structures would require upland excavation at Ice Harbor and Lower Monumental and channel excavation at all projects. Disposal of material is planned for upland sites along the shoreline downriver of the projects. Approximately 30-50 acres would be required for each of the four disposal site. All of the habitat associated with the excavation and disposal areas would be lost. Areas to be excavated are typically degraded grasslands, which have been impacted by overgrazing, vehicle traffic and project activities.

MIGRATORY CANAL

ANADROMOUS FISH

The migratory canal would appear to potentially increase juvenile salmonid survival by eliminating the hazards of passing dams, and reducing the exposure of outmigrants to predation. However, the canal would present many risks, as it is based on untried technology, and the effect of the canal on juvenile salmonids is unknown. It needs to be emphasized that outmigrating fish have biological requirements beyond a conveyance system during outmigration. Feeding, resting, temperature, depth and substrate requirements vary for different sizes and species of anadromous fish. Re-creating the range of biological, chemical and physical parameters needed by the mix of migrating and rearing salmon in a canal or tube would appear to be an impossible task. Our specific concerns are discussed below.

One major concern is the need for lift mechanisms at several locations along the canal to maintain necessary head for the system. This type of technology has the potential for impacting organisms subjected to it due to pressure changes, water velocity sheer zones and disorientation. The impact of these stress-inducing variables is even more pronounced on actively smolting fish due to the natural stress of the physiological changes occurring within the fish.

The feasibility of feeding the fish in the canal is unknown, and numerous problems exist. Feeding pelletized food to hatchery-reared fish may be possible, but maintenance of wild fish with pelletized food seems unlikely. There is also a problem with providing the appropriate range of food sizes for fish of different ages which would be in the canal. Artificial feeding may also reduce the ecological fitness for survival of hatchery-reared fish.

Another major concern is the establishment of resident fish populations within the canal and resting areas. Due to the confined area and anticipated densities of migrating juvenile salmonids, predator control and eradication within the canal and resting areas may not be feasible. Additionally, the presence of resident fish within the canal and resting areas may have negative effects due to competition for food and rearing areas.

Provided all of the other technical concerns could be surmounted, we are also concerned as to what long term selective pressures would be exerted on fish behavior by passage through a migratory canal. Alterations in genetics similar to those that occurred with hatchery fish are a real possibility.

TERRESTRIAL RESOURCES

The migratory canal concept, particularly its route, is likely to change should the alternative be carried to the feasibility level. Therefore, this discussion of impacts is general in nature.

The canal would be 35 feet wide by about 270 miles long. The area permanently impacted by the canal would be 1150 acres. It is expected that there would also be a significant amount of habitat disturbance adjacent to the canal during construction. Of this acreage, a significant portion, primarily along the lower Columbia River projects, would appear to be in areas with little wildlife habitat value, such as highway and railroad right-of-ways, urban areas and agricultural fields. The canal also passes through approximately 45 miles of tunnels and pipes, where it would not disturb wildlife or their habitat. The disposal of tailings from excavation, however, would probably result in wildlife habitat loss.

There are areas where wildlife habitat of significance would be affected. The proposed canal alignment appears to closely follow the shoreline on the Bonneville pool, where it would impact riparian vegetation. Loss of riparian vegetation along the Bonneville pool would affect wintering bald eagles and other raptors in particular, as well as other riparian dependent wildlife.

Upstream from The Dalles, shrub-steppe habitat would be most heavily affected by the canal, although wetlands and riparian habitats could also be affected. The actual impacts from loss of habitat, shrub steppe in particular, would depend on the quality of the habitat lost and would be more significant if unbroken tracts of habitat were fragmented. Besides impacts from actual construction, and associated roads and staging areas, rock and soil generated by tunnel construction would also require disposal. A disposal site has not been identified, but we assume that this large quantity of material would be placed on upland sites, which would impact shrub-steppe habitat. However, disposal areas such as ravines and drainages with higher habitat value have not been specifically excluded. The migratory canal could also disrupt surface and subsurface drainage patterns, which may affect water availability for vegetation at elevations below the canal.

The right-of-way would pass through a number of wildlife management areas and public areas with wildlife value along its route. These include various Corps-managed Habitat Management Units along the lower Snake River projects, McNary National Wildlife Refuge, Juniper Canyon HMU and Hatrock HMU on McNary, Three Mile Canyon and Willow Creek on John Day, 7 miles of the John Day Arm, the Deschutes Recreation area and Home Valley Park. It also would appear to pass through the grounds of the Spring Creek Fish hatchery. For the most part, the canal would pass through upland portions of these units, and avoids riparian zones and wetlands.

In addition to the actual canal, resting ponds are planned every ten miles, and would be located primarily in canyons or other drainages. These areas are typically vegetated with mesic shrubs. The resting ponds would result in the loss of 0.33 of an acre of this type of habitat at each site. Each of these sites are relatively small, and total acreage is relatively minor, but specific sites could be significant in the local context for deer, upland game birds, passerine birds and small mammals.

The canal would result in the permanent loss of a large amount of habitat, approximately 1150 acres, which translates into 4 acres/mile of canal. However, a portion of the habitat would be of marginal value to wildlife. The resting ponds would result in the loss of another 9 acres of habitat. In addition, the fencing which would be required for the canal would be a significant barrier to wildlife movement, particularly big game. Impacts would be most significant where the canal bisects tracts of high value wildlife habitat with little topographic relief, and daily movement of wildlife between the river and upland habitat occurs. Where canyons and ravines are present, wildlife movement patterns typically follow drainages, and effects on movement would be reduced. The exception would be if a resting pond were placed in the drainage, which would effectively block wildlife movement.

The effects on seasonal movements of big game would depend largely on the characteristics of the migration. If side canyons are being used, which is the probable case, these would be bridged by the canal, and movement would not be greatly impeded. Where side canyons are not present, movement would be disrupted to a greater extent.

Twenty-five treaty fishing access sites are located along the Columbia River between Boardman, Oregon, on the John Day pool and Bonneville Dam. The migratory canal could potentially disrupt or block access to these sites, or depending on the canal location, pass through the sites and their associated facilities.

FLEXIBLE IN-RESERVOIR SALMON PASSAGE TUBE

The salmon passage tube provides theoretical benefits to salmonids similar to the migratory canal. However, the uncertainty of the technology and probable negative effects to fish are even greater.

The use of a closed, pressurized conduit for fish bypass systems has been discouraged in the past due to impacts to fish. The potential for fatigue and elevated stress levels is high. Current bypass systems of short distance (<5,000 ft.) produce elevated stress levels (Congleton et al. 1991). Prolonged times in this type of system without appropriate rest areas would likely result in extreme stress and decreased survival.

The placement of resting areas in the flexible tube may be more critical in this alternative than for the migratory canal due to stress levels produced by the pressurized system. As mentioned earlier, the cumulative effect of minor stresses without a recovery period would result in decreased fish performance and survival.

It is also anticipated that debris would be a problem in the system. The lodging of debris in key areas of the system such as junctions and in-line pumps would result in descaling and fish mortality. However, debris removal and maintenance would be very difficult, as access to the conduit, except by divers, is not feasible.

In-line fish pumps to provide the necessary water velocity through the system also pose a source of potential stress and/or mortality to fish passing through the system. Fish would pass through pumps repeatedly and would be subject to descaling and injury at each pump location. Placement of pumps at intervals stated in the proposal pose cumulative and repeated stress events without adequate recovery time. This stress, while assumed to be minimal for one event, may pose greater impacts if successive events are additive.

We also have serious reservations about the feasibility of feeding the fish. Although feeding pelletized food to hatchery reared fish may be possible, we do not see how wild fish can be maintained.

The use of a transparent conduit, while beneficial to inspecting of the system may prove another potential stressor for fish in the system. The use of darkened areas and backgrounds is normally recommended to reduce stress and delay of fish through the bypass system.

A major feature that needs more detail is the requirement for drop mechanisms at several locations along the pipeline to maintain necessary head for the system. This type of technology has the potential for impacting organisms subjected to it due to pressure changes, water velocity sheer zones and disorientation. Sections of elevation loss may provide areas for fish to hold and delay and may provide favorable conditions for resident predators to station and feed. The impact of these stress-inducing variables is even more pronounced on actively smolting fish due to the natural stress of the physiological changes within the fish.

The enclosed system would need water exchange, oxygen and dissolved gas control. Conduit sections near resting areas or pumping sites may provide adequate water quality but it is unknown how water quality parameters would be maintained in sections not adjacent to rest areas or pumps. Due to the pressurized system, fish in the vicinity of entrained air may be injured or killed. Potential effects would therefore have to be addressed.

The presence of resident fish and adult salmonids entering this system would have to be addressed. Another major concern is the establishment of resident fish populations within the conduit and resting areas. Due to the confined area and anticipated densities of migrating juvenile salmonids, predator control and eradication within the conduit and resting areas may not be feasible. Additionally, the presence of resident fish within the conduit and resting areas may have negative effects due to competition for food and rearing areas. The transport of these fish below Bonneville would be considered an impact that must be avoided.

The substrate mentioned in the proposal could pose disease and predation problems by providing suitable habitat for pathogens and their vectors, and resident predators.

UPSTREAM COLLECTOR FACILITIES

ANADROMOUS FISH

The collector is a necessary feature if the migratory canal or tube are to be used or if increased transportation is desired. However, the upstream collector facilities and migratory canal alternatives present many unproven technological ideas. While current approach velocity criteria were used in the initial design, these criteria were established for much smaller screening devices (2,000 cfs maximum) with short exposure times for fish. Given the estimated screen length, current approach velocity criteria may not be suitable.

Debris and sediment would be major problems with this size of facility. Existing screening systems passing a few thousand cfs in protected situations have severe debris problems. Even with the upstream removal of large debris, smaller debris would concentrate in the collector/separator due to the 0.125 inch wedgewire mesh. This debris accumulation would be channeled into the collection facilities, resulting in probable fish handling stress and survival concerns. Current fish separator technology may not be usable under these kinds of debris loads. There is evidence of these problems at some existing fish separators during high debris load periods.

Sediment in the vicinity of the proposed facility site could be a major problem during periods of higher flows. Current information from the recent reservoir drawdown test shows areas of sediment deposit and sediment erosion near the site. The alterations of flow patterns at the facility would probably cause sediment deposition.

The ability to maintain the desired water velocities through the screen with changes in river flow, wind wave action and debris-sediment load are major concerns with this significant extrapolation of current technology. The flow conditions and patterns which would be created upstream of this facility would also be favorable for concentrating predators.

If the upstream collector is to be considered further, design concepts that address these concerns would need to be developed. Existing technology might be considered, such as the dam configuration at the Wells project, which collects a high percentage of outmigrants and a relatively small percentage of river flow.

RESIDENT FISH

An upstream collection facility would be a barrier to upstream movement of resident fish, white sturgeon in particular, which move up the Snake River from Lower Granite reservoir to spawn. Downstream movement of fish entering the reservoir for rearing would also be affected, although presumably resident fish could be sorted and returned to the river.

The dredging which would be required for the bypass channel at the Silcott Island site would convert shallow water to deep water habitat. The side channel at Silcott Island is presently a productive rearing and spawning habitat for resident fish. Dredging would eliminate these values. Major dredging would not be required at the sites on the Clearwater River and the Snake River above the confluence.

TERRESTRIAL RESOURCES

The side channel at Silcott Island is currently excellent habitat for aquatic furbearers, waterfowl and wading birds, because shallow water, emergent wetland and riparian habitats are present, and because of its proximity to the Chief Timothy HMU. Shallow water and emergent wetlands would be lost if the side channel was dredged, with a concurrent loss of wildlife value. It is also likely that disturbance from human activity at the site would increase, further reducing wildlife value. Losses of wildlife habitat at the other proposed sites, beyond losses directly resulting from facility construction, are likely to be minimal. These facilities may also block furbearer movement, particularly river otter, in the river. The concentration of fish at these facilities may also attract river otters, which may then have to be trapped to reduce predation.

DOWNSTREAM WEIR

The downstream weir(s) below each project may maintain current adult passage conditions in the tailrace and near the existing fishway entrances.

These structures may also alter adult fish approaches to the existing fishway entrances. Since the placement and formation of the weir is not described, the structure may provide several routes of passage past the weirs. These routes may change as head differential is increased or decreased and as river discharge is changed. Adverse adult passage conditions could also occur during periods of low river flow due to water loss from leakage the proposed rock filled weirs. These factors, plus altered flow patterns in the tailrace may impact the current fish passage conditions at the existing fishway facilities. Displacement of material due to river discharge may also occur. These changes may affect adult fish approaches.

SIDE CHANNEL SPILLWAY

The side channel spillways are difficult to assess in terms of juvenile fish passage. The siting of the discharge structure would have to be closely examined. Predators may be attracted to the outfall to prey on juveniles. The outfall site also may impact adult passage by providing false attraction flows. A model study is recommended to evaluate tailrace conditions.

THREATENED AND ENDANGERED SPECIES

In accordance with Section 7 of the Endangered Species Act of 1973, as amended, the Corps is required to assure that their actions have taken into consideration impacts to federally listed or proposed threatened or endangered species for all federally funded, constructed, permitted, or licensed projects.

The Service has determined that wintering bald eagles and peregrine falcons may occur in the vicinity of the project area. You may consider the attached list (Attachment A) as a response pursuant to Section 7(C) of the Act. The Corps should begin a biological assessment if it appears that the proposed construction project is a major construction activity. These responsibilities are described in Attachment B (Appendix B).

Candidate species are included simply as advance notice to federal agencies of species which may be proposed and listed in the future. However, protection provided to candidate species now may preclude possible listing in the future. If early evaluation of your project indicates that it is likely to adversely impact a candidate species, the Corps of Engineers may wish to request technical assistance from this office (Appendix B).

DISCUSSION

The alternatives being studied under the System Configuration Study offer theoretical benefits to anadromous fish resulting from increased in-river water particle velocity, or by removing juvenile fish from the river to eliminate their passage through the dams and the hazards of in-river migration. However, several of the alternatives obviously have potential negative impacts on anadromous fish as well, and/or require unproven, new technology and facilities, whose effectiveness cannot be adequately evaluated prior to its use. The Service is opposed to the concept of removal of anadromous salmonids from the riverine environment as part of a long-term solution to in-river passage problems. For these reasons, we recommend that the upstream collector facility, migratory canal and flexible tube alternatives be dropped from further consideration. We also recommend that the variable pool drawdown alternatives be dropped from consideration because of concerns with the pressurized juvenile bypass system. This would allow efforts to concentrate on those alternatives that show the most promise for improving the status of Snake River salmonid stocks.

Of the proposed alternatives, the greatest potential for anadromous fish benefits would be derived from the fixed pool and natural river drawdown alternatives, and further evaluation of these alternatives in Phase II is warranted. However, we are concerned that negative impacts to anadromous fish that may exist under the proposed alternatives would diminish the value of the benefits. The net benefit of these alternatives to anadromous fish has not yet been well quantified. The proposed alternatives also would have negative effects on resident fish and wildlife. An important point, however, is that the negative impacts are a result of the annual nature of the drawdowns being proposed. Although not proposed as alternatives, year-round partial or full drawdowns would permit the reestablishment of vegetation in the drawdown zone and a stabilization of the aquatic community. It would also eliminate the negative impacts to anadromous fish passage that occur during refill periods. The obvious conclusion is that the most clear-cut benefits to anadromous fish runs would come from permanent drawdowns or dam removal.

The stated objective of the SCS is to investigate project modifications to improve survival of anadromous fish. The Service is therefore of the opinion that in order to evaluate a full range of alternatives to improve the survival of anadromous fish stocks in the Snake River, alternatives to investigate the removal of one to four dams on the lower Snake River and permanent partial drawdowns to 33, 43 and 52 feet, or a combination thereof, should be included for further study by the Corps. A dam removal alternative would provide the closest possible conditions to the pre-dam river system for anadromous and resident fish and wildlife. Restoration of the ecosystem which was historically present would result in the greatest improvements in survival and productivity of anadromous fish species, while providing suitable conditions in the long term for resident fish and wildlife. It is recognized that there would be significant economic and social costs associated with actual implementation of this alternative, which would have to be evaluated and addressed, and that implementation of this alternative would require regional consensus.

A strategy for implementation which would result in the most rapid implementation with the least risk will need to be developed during feasibility. The Idaho proposal to modify Lower Granite, and then the other three projects, may be the best strategy. However, the best implementation strategy will be dependant on the alternative selected. Alternatives which utilize proven, accepted technology or which seek to restore historical river conditions (natural river or dam removal) will require evaluation after the physical changes in the structures have been made, but implementation of changes at other dams should not be contingent on the results of the evaluation. If changes are being implemented which involve new, untested technology, these should be evaluated prior to implementation at other projects. However, the Service is not likely to support major use of untested technology.

During the feasibility phase, the impacts of a full range of alternatives on fish and wildlife will need to be more thoroughly explored and quantified, as the magnitude of some impacts are not easily evaluated. Immediate losses which would occur are fairly obvious, but the extent of degradation of wetland and riparian habitats, changes in the composition of the resident fish community and loss of anadromous fish rearing habitat which would occur will require further evaluation.

The Service recognizes that there may be tradeoffs of positive and negative effects to fish and wildlife. Negative impacts from those alternatives that seek to restore historical aquatic systems may not require mitigation. Mitigating for some losses, such as exotic resident fish or predatory native species, such as northern squawfish, may not even be desirable. However, the alternatives proposed by the Corps continue to maintain a highly modified system, even if anadromous fish are benefitted. Therefore, impacts to native fish and wildlife populations and their habitat, and to existing wildlife mitigation sites, would require mitigation.

STUDY REQUIREMENTS

We have the following recommendations for studies and potential mitigation requirements should this project be carried into feasibility:

1) We recommend that the natural river option and constant pool drawdown alternatives, as well as the dam removal and permanent partial drawdown alternatives, be considered for the feasibility phase of the study. As part of the evaluation of these alternatives we recommend that:

- A sediment and bedload study be conducted to evaluate the effect of sediment transfer downstream past the projects and into the Snake River delta and McNary pool.

- An evaluation of the impacts to adult and juvenile resident and anadromous fish during drafting and refilling of the reservoir to normal operating elevation should be conducted. This should include an analysis of effects to population size and age structure of resident fish and an evaluation of the value of rearing habitat on the lower Snake River for juvenile salmonids.

- Hydraulic model testing and prototype testing to determine changes in forebay and turbine intake water velocity patterns should be conducted to provide information on possible changes to fish guidance efficiencies. Biological evaluations should also be conducted.

- Model testing and prototype testing is needed to evaluate the conditions within the modified adult fish facilities under the various drawdown alternatives. This should include evaluation of fishway exit and entrance conditions and attraction flows. Biological evaluations should also be conducted.

- Model testing is needed to evaluate tailrace conditions for side channel spillway.

- An analysis of the effects of gas supersaturation on anadromous and resident fish species should be completed. The Service has proposed laboratory research funded by Bonneville Power Administration which may be adequate for this analysis. The 1993 smolt monitoring program is collecting biological data from fish at various sampling sites.

2) A number of studies would be needed to fully evaluate the impacts of the project and mitigation needs for resident fish and wildlife. These include:

- Quantification of potential impacts to riparian and wetland vegetation, based on an evaluation of soil characteristics, soil moisture, and species specific water requirements for different plants, is needed. The potential of seed germination and plant growth within the drawdown zone should also be evaluated. Habitat losses and changes can then be predicted. Existing habitat quantity and quality should be evaluated through the use of HEP, although the HEP done for the Lower Snake River Fish and Wildlife Compensation Plan (USACE 1991) may provide adequate information. The quality and type of terrestrial habitat which would be lost as a result of construction should also be quantified using HEP. Mitigation sites, and their potential for enhancement, should be identified and evaluated.

- An evaluation of bird species diversity and densities in habitats to be affected by drawdown (Riparian, wetland, HMU's) should be conducted.

- Surveys of wetland habitats for amphibians are needed.

- Evaluations of what type of irrigation system would be required to continue irrigation of Habitat Management Units should be conducted.

- Where data are not available, detailed bathymetric studies should be conducted to provide the basis for the analysis of impacts to spawning and rearing habitat of resident fish, riparian and wetland vegetation, establishment of vegetation in the drawdown zone and predator access to islands.

- An intensive mollusc survey should be carried out at sites which may still harbor components of the native mollusc community. These sites are most likely to occur in tailraces and tributaries. Based on the survey, a plan should be developed to identify sites where native species might be maintained under the drawdown alternatives.

- A systematic plant survey should be conducted within the affected area to identify locations of rare, threatened and endangered plants and potential sites for maintenance and enhancement, if possible, of these plant populations.

- Raptor surveys, including winter bald eagles surveys, should be conducted to characterize raptor use of riparian zones.

- An evaluation of aquatic furbearer use of the reservoir is needed to evaluate the effects of reservoir drawdown.

- Sites with the potential for fish stranding should be identified and the means to provide an outlet for fish should be addressed. This is particularly needed for culverted subimpoundments.

- A post-implementation study of effects to resident fish, including an evaluation of food resources, is needed. A mitigation program to maintain sport fisheries compatible with the anadromous fishery should be developed based on the results of the study.

3) Should the Upstream Collector Facility not be dropped from further consideration the following research and evaluation would be required:

- Evaluation of debris loading of fish separator facilities of this size and possible methods to alleviate this problem. This research is necessary to determine if adequate fish separator technology can be developed.

- Analysis of sediment deposition and erosion in the area upstream and in the vicinity of the Upstream Collector Facility.

- Research to establish criteria for screening facilities passing more than 2,000 cfs. This research should verify and establish criteria for approach velocities, fish exposure in front of screening sections, and maximum distance of continuous screen area for yearling and subyearling age fish. A biological evaluation would need to be conducted to address these criteria once they were established.

- Design and siting of the Upstream Collector Facility should be coordinated with the National Marine Fisheries Service, Idaho Department of Fish and Game, Washington Department of Fisheries, Washington Department of Wildlife, Oregon Department of Fish and Wildlife and the U.S. Fish and Wildlife Service.

MITIGATION/ENHANCEMENT OPPORTUNITIES

RESIDENT FISH

Resident fish habitat would be drastically affected throughout the lower Snake River projects by drawdowns and affected on a local scale by the collector facilities. Movement would also be impaired. As previously mentioned, however, it may not be desirable to mitigate for all reductions in resident fish species, particularly exotic non-game species or species that are predators on juvenile salmonids. Complete mitigation of some effects may also be very difficult, as the entire intent of drawdown proposals is to simulate riverine conditions for part of the year and eliminate the lacustrine conditions favorable for other species.

Means to partially mitigate effects to resident fish are available, however.

- Stranding during drawdown can be reduced by providing outlets for pools and backwaters where fish could be stranded.

- Shallow water and side channel habitat could also be created to replace habitat lost to construction.

- Upstream movement of resident fish, particularly white sturgeon, must be assured by providing appropriate structures for passage through the upstream collector. Downstream migrants should be separated and passed downstream.

- The potential to maintain warm-water sport fishing opportunities may be available in backwaters. This would be contingent on being able to maintain water in the backwater through the drawdown period. This may require sealing of the bottom and/or road and railroad grade, and installation of water control structures.

TERRESTRIAL RESOURCES

Direct losses of wildlife habitat requiring mitigation would result from construction of the Upstream Collector Facility, bypass structures and the migratory canal. Mitigation of effects to wildlife and its habitat resulting from drawdown alternatives would also be required. Potential mitigation possibilities include:

- Route the canal to minimize crossings of streams, wetlands and environmentally sensitive areas.

- Route the canal around, rather than through, wildlife areas.

- Provide small diversions from the migratory canal to irrigate vegetation and create wetlands.

- Provide wildlife crossings over the canal at appropriate intervals.

- For unavoidable habitat losses, purchase and restore degraded upland shrub steppe and riparian sites.

- If project structures are modified, provide the means to divert continuous flow at each project throughout the year in a manner similar to that at the McNary Wildlife Area. This water would be used to develop riparian and wetland habitat downstream from dams, and a fishery could also be developed in the stream. Excess material from excavation could also be used to construct ponds in the reservoir below MOP, which could be fed continuously with water throughout the drawdown period from this source. It would also provide potential locations for a put-and-take fishery during the drawdown period. Construction and placement of these impoundments would have to be compatible with anadromous fish requirements.

- Modify existing irrigation systems on HMU's so that irrigation could be continued.

- Provide predator-proof goose nesting structures which would still be functional during drawdowns.

- If suitable vegetation does not naturally regenerate along the shoreline under drawdown conditions, seeding of strategic locations in the drawdown zone with forage mixtures for geese may be desirable.

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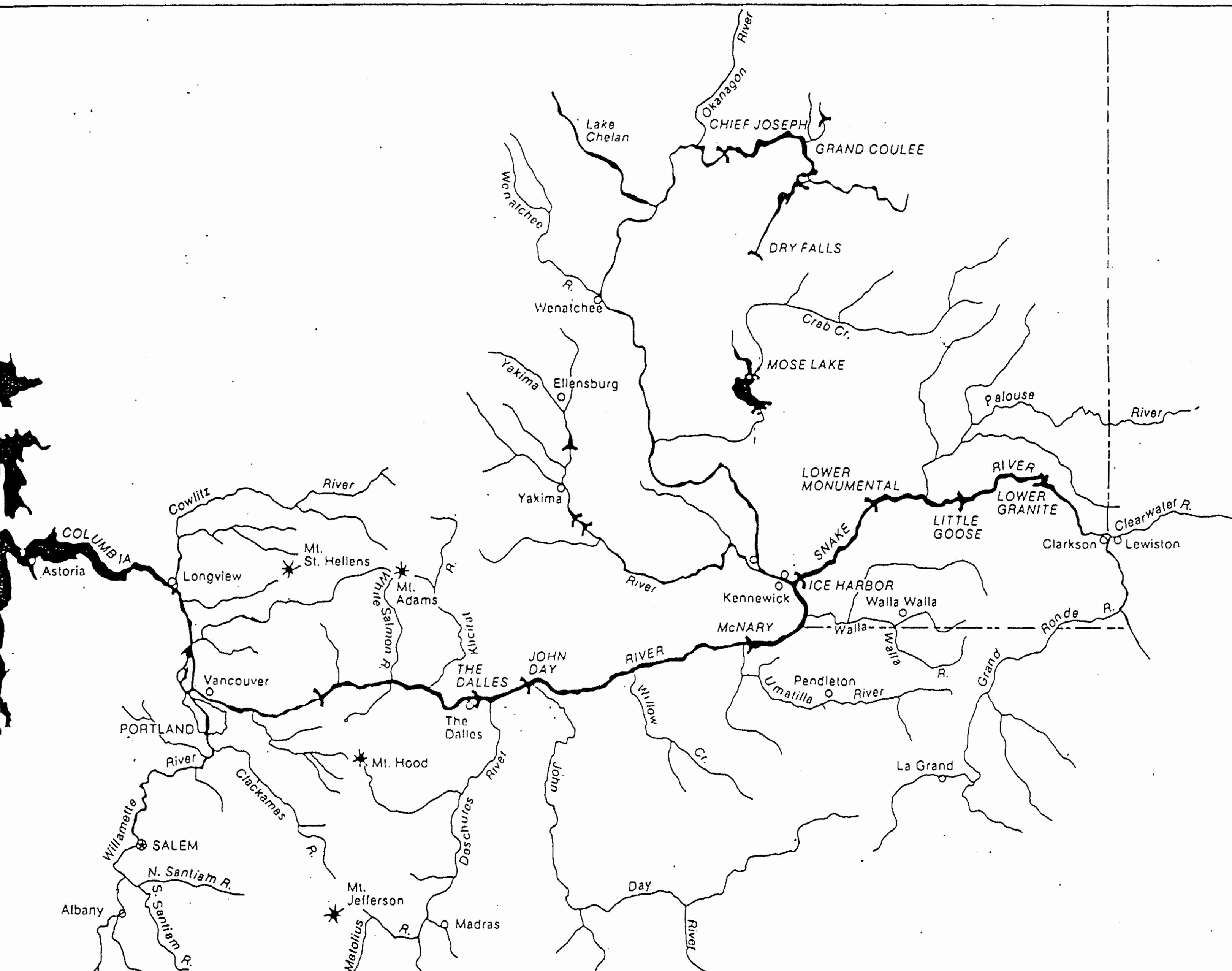
APPENDIX A

(Project Area)

bia and Snake River Projects



APPENDIX B

(Listed and Proposed Endangered and Threatened Species List)

ATTACHMENT A

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES WHICH MAY OCCUR WITHIN THE STUDY AREA FOR THE SYSTEM CONFIGURATION STUDY ALONG THE COLUMBIA AND SNAKE RIVERS BETWEEN LEWISTON, IDAHO AND BONNEVILLE DAM ON THE COLUMBIA RIVER IN WASHINGTON/OREGON.

1-3-92-SP-035/1-4-93-SP-27

LISTED

Bald eagle (*Haliaeetus leucocephalus*) - wintering bald eagles along the Columbia and Snake River from October 31 to March 31.

Peregrine falcon (*Falco peregrinus*) - Hack sites/aeries are present and fall and spring migrants pass through the study area.

Major concerns that should be addressed in your biological assessment of the project impacts to listed species are:

1. Level of use of the project area by listed species.

2. Effect of the project on listed species' primary food stocks and foraging areas in all areas influenced by the project.

3. Impacts from project construction (i.e., habitat loss, increased noise levels, increased human activity) which may result in disturbance to listed species and/or their avoidance of the project area.

PROPOSED

None

CANDIDATE

ANIMALS

Black tern (*Chlidonias niger*) - may occur in the project area.

Bull trout (*Salvelinus confluentus*) - may occur in the project area.

California floater (*Anodonta californiensis*) - may occur in the project area.

Columbia River Tiger beetle (*Cicindela columbica*) - may occur in the project area.

Ferruginous hawk (*Buteo regilis*) - may occur in the project area.

Larch Mountain salamander (*Plethodon larselli*) - may occur in the project area.

Long-billed curlew (*Numenius americanus*) - may occur in the project area.

Northern red-legged frog (*Rana aurora aurora*) - may occur in the project area.

Spotted frog (*Rana pretiosa*) - may occur in the project area.

Western pond turtle (*Clemmys marmorata*) - may occur in the project area.

PLANTS

Barrett's penstemon (*Penstemon barrettiae*) - may occur in the project area.

Columbia cress (*Rorippa columbiae*) - may occur in the project area.

Howell's fleabane (*Erigeron howelli*) - may occur in the project area.

Northern wormwood (*Artemesia campestris*) - may occur in the project area.

Northwest raspberry (*Rubus nigerrimus*) - may occur in the project area.

Obscure buttercup (*Ranunculus reconditus*) - may occur in the project area.

Oregon sullivantia (*Sullivantia oregana*) - may occur in the project area.

ATTACHMENT B

FEDERAL AGENCIES' RESPONSIBILITIES UNDER SECTIONS 7(a) AND 7(c) OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED

SECTION 7(a) - Consultation/Conference

Requires:

1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2. Consultation with FWS when a federal action may affect a listed endangered or threatened species to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the federal agency after it has determined if its action may affect (adversely or beneficially) a listed species; and

3. Conference with FWS when a federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or an adverse modification of proposed critical habitat.

SECTION 7(c) - Biological Assessment for Construction Projects *

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which is/are likely to be affected by a construction project. The process is initiated by a federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, please verify the accuracy of the list with our Service. No irreversible commitment of resources is to be made during the BA process which would result in violation of the requirements under Section 7(a) of the Act. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an onsite inspection of the area to be affected by the proposal, which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within the FWS, National Marine Fisheries Service, state conservation department, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures; and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. Upon completion, the report should be forwarded to our Endangered Species Division, 3704 Griffin Lane SE, Suite 102, Olympia, WA 98501-2192.

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* "Construction project" means any major federal action which significantly affects the quality of the human environment (requiring an EIS), designed primarily to result in the building or erection of human-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes federal action such as permits, grants, licenses, or other forms of federal authorization or approval which may result in construction.

APPENDIX C
(Comments Received From Other Agencies)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
ENVIRONMENTAL & TECHNICAL SERVICES DIVISION
911 NE 11th Avenue - Room 620
PORTLAND, OREGON 97232
503/230-5400 FAX 503/230-5435

JUN 7 1993 F/NWO3

Mr. John Grettenberger
U.S. Fish and Wildlife Service
3704 Griffin Lane SE, Suite 102
Olympia, Washington 98501-2192

Dear Mr. Grettenberger:

As requested, we reviewed your draft Planning Aid Report (PAR) on the U.S. Army Corps of Engineers' Columbia Basin Salmon Mitigation Analysis - System Configuration Study (May 1993). The draft includes discussion of the Snake River Drawdown, Migratory Canal, and Upstream Collector alternatives. We previously provided comment on a preliminary draft of the PAR in December 1992. The following comments pertain primarily to new information subsequently added to the PAR.

<u>General Comment</u>

While we share many of your stated concerns relative to the feasibility of successful implementation of this alternative, we continue to support completion of the reconnaissance level study of the upstream collector alternative. Based on the findings of that study, a decision whether to proceed with further study should be made by the region.

<u>Specific Comments</u>

Page 5, para. 3: The PAR should refer to low tailwater adult "fishways" rather than fish "ladders." For example, required modifications would likely include new powerhouse transportation channels and lower elevation main fishway entrances.

Page 25, para. 2: Transportation of juvenile salmonids by barge would not be possible during drawdown conditions because of navigation lock interruptions; however, truck transportation would be feasible. Truck transport would be limited to equipment capability.

Bottom of Page 25: Suggest you replace the second sentence with the following: "Drafting of the reservoirs would reduce the effective surface area of vertical barrier screens and would create adverse hydraulic conditions for juvenile fish in the gatewell."

Page 36, Anadromous Fish, new paragraph: We suggest addition of the following paragraph at the bottom of this section:

> If the upstream collector is to be considered further, design concepts that address these concerns would need to be developed. Existing technology might be considered, such as the dam configuration at Wells Dam which collects a high percentage of outmigrants in a relatively small percentage of the river flow (about 5 percent), which could allow screening in a more conventional manner.

Page 37, Downstream Weir: Adverse adult passage conditions could also occur during periods of low river flow due to water loss from leakage through the proposed rock-filled weirs.

Page 38, Side Channel Spillway: The siting of the sluiceway discharge structure would have to be closely examined. For example, predators would be attracted to the outfall to prey on juveniles and there is potential for false attraction of adult salmonids to the site.

Page 38, Discussion: We suggest that the PAR clearly state reservations relative to the upstream collector concept but this alternative not be dropped from further consideration at this time. We believe the reconnaissance level report should be completed to allow adequate consideration of this alternative.

Page 39, para. 2: We support inclusion in the System Configuration Study of a new alternative to investigate removal of one to four dams on the lower Snake River to improve survival of anadromous salmonids.

Thank you for the opportunity to comment. If you have any questions about these comments, contact Jim Ceballos of my staff at (503) 230-5405.

Sincerely,

Merritt E. Tuttle
Division Chief

cc: Craig Tuss, USFWS-FAO Vancouver