Hydro Appendix DRAFT

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60. Adult PIT Tag Program
72. Bonneville Flow Deflectors
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82. Burbank #2 and #3 Pumps
83. Columbia River Return Water Quality Monitoring Plan
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85. Investigate surface bypass RWSW at Lower Monumental Dam and install the unit in multiple spillways as warranted **[Under Development]**
86. State-of-the-art turbine design technology at The Dalles and Ice Harbor **[Under Development]**
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88. COE to develop and construct spillway deflectors at Chief Joseph Dam to minimize TDG **[Under Development]**

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100. Water Quality Effects on Bull Trout Survival Near Hydro-projects
101. Juvenile Salmon Transportation Evaluations
102. Bull Trout Distribution, Timing, and Usage of the Lower Snake River Reservoirs
103. Dworshak Reservoir Bull Trout Distribution to North Fork of the Clearwater River

References:

Fish Passage Plan

I. Hydro Programs and Actions

Hydro Programs

FCRPS hydro programs are implemented through the Regional Forum, an institutional structure and organization established to implement the 1995 NMFS Biological Opinion. The Regional Forum is composed of Federal, State, and Tribal fish and wildlife managers that meet regularly to provide advice to the Action Agencies on a range of hydro system programs. A policy group called the Implementation Team (IT) leads the Forum. The IT oversees the work of several subgroups: the Technical Management Team (TMT), the System Configuration Team (SCT), the Water Quality Team (WQT), and the Fish Passage Operations and Maintenance Coordination Team (FPOM). The work of these teams is summarized later in this section of the Hydro Appendix.

Reasonable and Prudent Actions (RPA's) identified in the NMFS and FWS Biological Opinions number in the hundreds. These RPA's and projects proposed by the Action Agencies to implement them are summarized on the Actions Charts enclosed at the end of this chapter. A modified NMFS Appendix F is provided to help correlate proposed Hydro projects with the NMFS RPA's.

Hydro Actions

The Draft Implementation plan contains a list of projects that the Action Agencies have defined in response the Biological Opinions. This appendix provides about 100 project specific work plans that the action agencies have prepared for proposed Hydro System projects. The work plans provide: detailed project descriptions; the purpose and objective of the project; major activities and tasks; milestones and schedule information; cost estimates; key issues associated with the project; and the reasonable and prudent actions of the Biological Opinions to which the project is targeted.

Projects frequently change both in scope and schedule. The work plans contained in this appendix represent the concept and estimates of agency staff at the time of this publication. We know that these plans will change, and updated plans will be inserted within this appendix periodically. Reviewers are referred to the list of agency contacts (included below) to obtain additional information regarding these work plans.

Hydro System Action Charts

The large number of actions that are planned required the development of a project numbering system. The attached Hydro System Action Charts contain the Hydro Action Project Number (first column), the Project Title, the category and subcategory into which the project falls, the lead federal agency for the project, the priority for the project (not yet completed), the source of funding for the project, the biological rational for the project, the Evolutionally Significant Unit (ESU) that the action would benefit, the NMFS or FWS reasonable and prudent action(s) to which the project responds and linkages to key research, monitoring, and evaluation (RM&E). The tables provide an overview of the work plans contained in this appendix.

Detailed work plans have not yet been developed for the reasonable and prudent measures contained in the FWS Biological Opinion (with the exception of the VarQ Flood Control Operation). The attached work plans thus focus almost exclusively on the NMFS RPA's. Work plans for projects and studies called for in the FWS Biological Opinion will be developed this spring and summer and the appendix will be updated as these work plans are completed.

NMFS Action - Action Agency Project Crosswalk Table

07-Jun-01

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency	
		11	11	Bonneville Flat Plate	SYSTEM CONFIGURATION	COE	
		19	19	Multiple Bypass Accumulative Impacts		COE	
		27	27	McNary Cylindrical Dewatering Prototype Evaluations		COE	
		52	52	Adult Upstream Migration Studies		COE	
		64	64	Five-Year Water Management Plan (5-WMP)	WATER MANAGEMENT	COE	* Shared Lead
		64	64			BLM	* Shared Lead
		64	64			PM	* Shared Lead
		70	70	Water Quality Plan, 1-Year	WATER QUALITY	COE	
3		63	63	Annual Water Management Plan (1-WMP)	WATER MANAGEMENT	COE	
5		70	70	Water Quality Plan, 1-Year	WATER QUALITY	COE	
		71	71	Water Quality Plan, 5-Year		COE	
6		61	61	Fish Passage Plan (FPP)	OPERATIONS & MAINTENANCE	COE	
		62	62	One and Five-Year Operations and Maintenance Plan and Budget		COE	
11		61	61	Fish Passage Plan (FPP)		COE	
14		63	63	Annual Water Management Plan (1-WMP)	WATER MANAGEMENT	COE	
15		63	63			COE	
16		63	63			COE	
17		63	63			COE	
18		63	63			COE	

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency	
19		63	63	Annual Water Management Plan (1-WMP)	WATER MANAGEMENT	COE	
		70	70	Water Quality Plan, 1-Year	WATER QUALITY	COE	
		71	71	Water Quality Plan, 5-Year		COE	
		527	92	Ensure that Hungry Horse refills in a timely manner without spill that causes excessive TDG	WATER MANAGEMENT	BOR	
20		63	63	Annual Water Management Plan (1-WMP)		COE	
21		63	63			COE	
22		69	69	VARQ Flood Control Operation		COE	* Shared Lead
		69	69			BOR	* Shared Lead
24		63	63	Annual Water Management Plan (1-WMP)		COE	
		528	93	Annual Report on Treaty Canadian Water Storage		COE	* Shared Lead
		528	93			BPA	* Shared Lead
25		63	63	Annual Water Management Plan (1-WMP)		COE	
		529	94	Annual Report on Non-Treaty Canadian Water Storage		COE	* Shared Lead
		529	94			BPA	* Shared Lead
26		63	63	Annual Water Management Plan (1-WMP)		COE	
		530	95	Annual Report Additional Canadian Water Storage and Shaping		BPA	* Shared Lead
		530	95			COE	* Shared Lead
27		76	76	Agreements for uncontracted water or storage space at Bureau reservoirs		BOR	
28		65	65	BOR Water Conservation Improvements		BOR	
29		66	66	Report on Unauthorized Use of BOR Water		BOR	
30		77	77	Site specific consultations for BOR projects located downstream from Chief Joseph Dam		BOR	

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
31		68	68	Banks Lake Drawdown Study	WATER MANAGEMENT	BOR
32		67	67	Water Acquisition from Reclamation’s Upper Snake River Basin Projects		BOR
33		78	78	Modify water supply to the Dworshak NFH while maintaining discharges of Dworshak cold water	SYSTEM CONFIGURATION	COE
34		55	55	Adult Temperature Evaluation		COE
35		75	75	John Day Surface Bypass/Removable Spillway Weir/Flow Deflectors		COE
		79	79	Feasibilty analysis of flood operations to benefit Columbia River ecosystem and salmon.	WATER MANAGEMENT	COE
36		80	80	Develop, and implement a revised storage plan for Libby reservoir		COE
37		81	81	Investigate attraction of listed fish into wasteways from the Columbia Basin Project	SYSTEM CONFIGURATION	BOR
38		82	82	BOR shall install screens at the canal intakes to Burbank #2 and #3 pump plants.		BOR
39		83	83	Investigate water quality of each point of return flows from the Columbia Basin Project		BOR
40		63	63	Annual Water Management Plan (1-WMP)	WATER MANAGEMENT	COE
41		63	63			COE
42		63	63			COE
43		63	63			COE
45		536	101	Juvenile Salmon Transportation Evaluations	OPERATIONS & MAINTENANCE	COE
46		536	101			COE

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
47		12	12	Delayed Mortality of Juveniles with Differential Migration Histories	SYSTEM CONFIGURATION	COE
		22	22	Evaluation of Transportation Strategies		COE
		536	101	Juvenile Salmon Transportation Evaluations	OPERATIONS & MAINTENANCE	COE
49		22	22	Evaluation of Transportation Strategies	SYSTEM CONFIGURATION	COE
		536	101	Juvenile Salmon Transportation Evaluations	OPERATIONS & MAINTENANCE	COE
50		50	50	Adult Pit Tag Monitoring @ Bonneville, The Dalles , and John Day	SYSTEM CONFIGURATION	COE
		51	51	McNary Adult Pit Tag Program		COE
52		22	22	Evaluation of Transportation Strategies		COE
		536	101	Juvenile Salmon Transportation Evaluations	OPERATIONS & MAINTENANCE	COE
53		18	18	Lower Snake River Juvenile Bypass System Improvements	SYSTEM CONFIGURATION	COE
		20	20	Separator Evaluation		COE
		26	26	Little Goose Pit-Tag System Modification		COE
		63	63	Annual Water Management Plan (1-WMP)	WATER MANAGEMENT	COE
54		63	63			COE
55		532	97	Schultz-Hanford Transmission Reinforcement	OPERATIONS & MAINTENANCE	BPA
56		531	96	Columbia Falls Reinforcement		BPA
		533	98	West Of Hatwaii Transmission Reinforcement		BPA
57		534	99	Report on new non-hydro generation resources		BPA

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
58		61	61	Fish Passage Plan (FPP)	OPERATIONS & MAINTENANCE	COE
		63	63	Annual Water Management Plan (1-WMP)	WATER MANAGEMENT	COE
59		23	23	Turbine Passage Survival Program	SYSTEM CONFIGURATION	COE
60		41	41	Bonneville Adult Fallback		COE
61		7	7	Bonneville 1st Powerhouse Surface Bypass (Deep Slot)		COE
62		8	8	Bonneville 1st Powerhouse FGE Improvements		COE
63		8	8			COE
64		23	23	Turbine Passage Survival Program		COE
65		3	3	Bonneville 2nd Powerhouse JBS Improvements		COE
66		6	6	Bonneville 2nd Powerhouse Surface Bypass (corner collector)		COE
67		9	9	Bonneville 2nd Powerhouse FGE Improvements		COE
69		2	2	The Dalles Surface Bypass Studies		COE
		32	32	Dalles Project Survival Study		COE
70		38	38	The Dalles Sluice Outfall and Auxiliary Adult Water Supply		COE
71		74	74	John Day Spill/Survival Studies		COE
72		75	75	John Day Surface Bypass/Removable Spillway Weir/Flow Deflectors		COE
73		36	36	John Day Extended Length Screens		COE
74		17	17	McNary Extended Submerged Bar Screens		COE
		27	27	McNary Cylindrical Dewatering Prototype Evaluations		COE
		28	28	McNary Juvenile Fish Facility Debris		COE
		37	37	McNary outfall evaluation		COE

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
75		84	84	Investigate surface bypass RWSW at McNary Dam & install the unit in multiple spillways as warranted	SYSTEM CONFIGURATION	COE
76		25	25	Lower Monumental Juvenile Bypass System Outfall		COE
		33	33	Lower Monumental Gas Fast Track Deflectors		COE
77		85	85	Investigate surface bypass RWSW at Lower Monumental Dam and install the unit in multiple spillways		COE
78		16	16	Lower Monumental Extended Submerged Bar Screens		COE
79		29	29	Little Goose Trash Boom		COE
80		13	13	Lower Granite Surface Bypass and Collection		COE
81		20	20	Separator Evaluation		COE
		24	24	Lower Granite Juvenile Bypass System		COE
82		10	10	Bonneville Juvenile Fish Bypass Studies		COE
		30	30	Ice Harbor Spillway Survival Study		COE
		31	31	McNary Spillway Survival Study		COE
		74	74	John Day Spill/Survival Studies		COE
83		10	10	Bonneville Juvenile Fish Bypass Studies		COE
		30	30	Ice Harbor Spillway Survival Study		COE
		31	31	McNary Spillway Survival Study		COE
		74	74	John Day Spill/Survival Studies		COE
84		6	6	Bonneville 2nd Powerhouse Surface Bypass (corner collector)		COE
85		13	13	Lower Granite Surface Bypass and Collection		COE
86		2	2	The Dalles Surface Bypass Studies		COE
		6	6	Bonneville 2nd Powerhouse Surface Bypass (corner collector)		COE

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
86		7	7	Bonneville 1st Powerhouse Surface Bypass (Deep Slot)	SYSTEM CONFIGURATION	COE
		13	13	Lower Granite Surface Bypass and Collection		COE
		75	75	John Day Surface Bypass/Removable Spillway Weir/Flow Deflectors		COE
87		26	26	Little Goose Pit-Tag System Modification		COE
88		23	23	Turbine Passage Survival Program		COE
89		23	23			COE
90		23	23			COE
		60	60	Adult PIT tag monitoring- Snake River projects		COE
91		23	23	Turbine Passage Survival Program		COE
92		86	86	Consider turbine design technology to decrease fish injury at The Dalles & Ice Harbor		COE
93		23	23	Turbine Passage Survival Program		COE
94		14	14	Little Goose Extended Submerged Bar Screens		COE
		15	15	Lower Granite Extended Submerged Bar Screens		COE
		16	16	Lower Monumental Extended Submerged Bar Screens		COE
		18	18	Lower Snake River Juvenile Bypass System Improvements		COE
		26	26	Little Goose Pit-Tag System Modification		COE
		27	27	McNary Cylindrical Dewatering Prototype Evaluations		COE
95		20	20	Separator Evaluation		COE
96		14	14	Little Goose Extended Submerged Bar Screens		COE
		17	17	McNary Extended Submerged Bar Screens		COE
97		4	4	Bonneville 1st Powerhouse JBS Improvements		COE

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
97		7	7	Bonneville 1st Powerhouse Surface Bypass (Deep Slot)	SYSTEM CONFIGURATION	COE
		8	8	Bonneville 1st Powerhouse FGE Improvements		COE
		15	15	Lower Granite Extended Submerged Bar Screens		COE
98		36	36	John Day Extended Length Screens		COE
		75	75	John Day Surface Bypass/Removable Spillway Weir/Flow Deflectors		COE
99		13	13	Lower Granite Surface Bypass and Collection		COE
		16	16	Lower Monumental Extended Submerged Bar Screens		COE
		526	91	By January 2003, develop an analysis on ESBS's vs. RSW's at Lower Monumental		COE
100		87	87	Salmonid predation studies as required		BPA
101		87	87			BPA
102		87	87			BPA
103		87	87			BPA
104		87	87			BPA
105		21	21	Juvenile Salmon Temperature Studies		COE
106		58	58	Marine mammal predation @Bonneville tailrace		COE
108		59	59	Investigate adult headburn		COE
109		53	53	Kelt Studies		COE
110		44	44	John Day Salmonid Holding and Jumping Project		COE
111		23	23	Turbine Passage Survival Program		COE
112		40	40	McNary/Ice Harbor Adult Fallback Project		COE
113		41	41	Bonneville Adult Fallback		COE

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
114		45	45	John Day Ladder Temperature Project	SYSTEM CONFIGURATION	COE
		54	54	Fish Ladder Temperature Evaluation		COE
		55	55	Adult Temperature Evaluation		COE
115		55	55			COE
116		44	44	John Day Salmonid Holding and Jumping Project		COE
		55	55	Adult Temperature Evaluation		COE
		56	56	Adult Fish Transition Pool Evaluations		COE
119		57	57	Adult Lamprey Passage		COE
120		42	42	Bonneville 2nd Powerhouse Adult Fishway Auxiliary Water Supply		COE
121		62	62	One and Five-Year Operations and Maintenance Plan and Budget	OPERATIONS & MAINTENANCE	COE
122		38	38	The Dalles Sluice Outfall and Auxiliary Adult Water Supply	SYSTEM CONFIGURATION	COE
123		39	39	The Dalles Adult Entrance Channel Dewatering Modifications		COE
127		42	42	Bonneville 2nd Powerhouse Adult Fishway Auxiliary Water Supply		COE
128		43	43	John Day North Shore - Adult Fishway Auxiliary Water Supply		COE
129		46	46	Lower Granite Adult Fishway Auxiliary Water Supply Project		COE
		47	47	Lower Monumental Adult Fishway Auxiliary Water Supply Project		COE
		48	48	Little Goose Adult Fishway Auxiliary Water Supply Project		COE
		49	49	Ice Harbor Adult Fishway Auxiliary Water Supply Project		COE
130		70	70	Water Quality Plan, 1-Year	WATER QUALITY	COE
131		70	70			COE

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
132		70	70	Water Quality Plan, 1-Year	WATER QUALITY	COE
133		71	71	Water Quality Plan, 5-Year		COE
134		33	33	Lower Monumental Gas Fast Track Deflectors	SYSTEM CONFIGURATION	COE
		34	34	Little Goose Gas Fast Track Deflectors		COE
		35	35	McNary Gas Fast Track Deflectors		COE
		72	72	Bonneville Gas Fast Track		COE
		73	73	The Dallles Gas Fast Track		COE
		75	75	John Day Surface Bypass/Removable Spillway Weir/Flow Deflectors		COE
135		33	33	Lower Monumental Gas Fast Track Deflectors		COE
		34	34	Little Goose Gas Fast Track Deflectors		COE
		35	35	McNary Gas Fast Track Deflectors		COE
136		88	88	COE to develop and construct spillway deflectors at Chief Joseph Dam to minimize TDG.		COE
137		89	89	Investigate TDG abatement at Libby Dam and installation of spillway deflectors /additional turbines		COE
138		13	13	Lower Granite Surface Bypass and Collection		COE
		75	75	John Day Surface Bypass/Removable Spillway Weir/Flow Deflectors		COE
139		90	90	COE to investigate TDG abatement at Dworshak Dam and implement options as warranted.	OPERATIONS & MAINTENANCE	COE
140		75	75	John Day Surface Bypass/Removable Spillway Weir/Flow Deflectors	SYSTEM CONFIGURATION	COE
141		21	21	Juvenile Salmon Temperature Studies		COE
142		21	21			COE

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
143		21	21	Juvenile Salmon Temperature Studies	SYSTEM CONFIGURATION	COE
144		61	61	Fish Passage Plan (FPP)	OPERATIONS & MAINTENANCE	COE
145		62	62	One and Five-Year Operations and Maintenance Plan and Budget		COE
146		1	1	Bonneville Automated Trashracks	SYSTEM CONFIGURATION	COE
		5	5	Bonneville 2nd Powerhouse Gatewell Debris Removal		COE
		27	27	McNary Cylindrical Dewatering Prototype Evaluations		COE
		36	36	John Day Extended Length Screens		COE
		62	62	One and Five-Year Operations and Maintenance Plan and Budget	OPERATIONS & MAINTENANCE	COE
181		536	101	Juvenile Salmon Transportation Evaluations		COE
182		536	101			COE
185		12	12	Delayed Mortality of Juveniles with Differential Migration Histories	SYSTEM CONFIGURATION	COE
		536	101	Juvenile Salmon Transportation Evaluations	OPERATIONS & MAINTENANCE	COE
186		12	12	Delayed Mortality of Juveniles with Differential Migration Histories	SYSTEM CONFIGURATION	COE
189		12	12			COE
191		536	101	Juvenile Salmon Transportation Evaluations	OPERATIONS & MAINTENANCE	COE
192		50	50	Adult Pit Tag Monitoring @ Bonneville, The Dalles , and John Day	SYSTEM CONFIGURATION	COE
195		536	101	Juvenile Salmon Transportation Evaluations	OPERATIONS & MAINTENANCE	COE

NMFS Action	FWS Action	Project ID	Hydro ID	ProjectTitle	CategoryType	Lead Agency
199		21	21	Juvenile Salmon Temperature Studies	SYSTEM CONFIGURATION	COE
	FWS10.A.3(1)	535	100	Water Quality Effects on Bull Trout Survival Near Hydro-projects	OPERATIONS & MAINTENANCE	COE
	FWS10.A.3(1)	537	102	Bull Trout Distribution, Timing, and Usage of the Lower Snake River Reservoirs		COE
	FWS10.A.3(2)	538	103	Dworshak Reservoir Bull Trout Distribution to North Fork of the Clearwater River		COE

Hydro System Implementation Plan Projects

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CategoryType	ProjectTitle	Project ID	Hydro ID	NMFS Action	FWS Action	Lead Agency
SYSTEM CONFIGURATION	Bonneville Automated Trashracks	1	1	146		COE
	The Dalles Surface Bypass Studies	2	2	69		COE
		2	2	86		COE
	Bonneville 2nd Powerhouse JBS Improvements	3	3	65		COE
	Bonneville 1st Powerhouse JBS Improvements	4	4	97		COE
	Bonneville 2nd Powerhouse Gatewell Debris Removal	5	5	146		COE
	Bonneville 2nd Powerhouse Surface Bypass (corner collector)	6	6	84		COE
		6	6	86		COE
		6	6	66		COE
	Bonneville 1st Powerhouse Surface Bypass (Deep Slot)	7	7	97		COE
		7	7	61		COE
		7	7	86		COE
	Bonneville 1st Powerhouse FGE Improvements	8	8	97		COE
		8	8	62		COE
		8	8	63		COE
	Bonneville 2nd Powerhouse FGE Improvements	9	9	67		COE
	Bonneville Juvenile Fish Bypass Studies	10	10	82		COE
		10	10	83		COE
	Bonneville Flat Plate	11	11			COE
	Delayed Mortality of Juveniles with Differential Migration Histories	12	12	47		COE
		12	12	189		COE
		12	12	185		COE
		12	12	186		COE
	Lower Granite Surface Bypass and Collection	13	13	86		COE
		13	13	80		COE

CategoryType	ProjectTitle	Project ID	Hydro ID	NMFS Action	FWS Action	Lead Agency
SYSTEM CONFIGURATION	Lower Granite Surface Bypass and Collection	13	13	138		COE
		13	13	85		COE
		13	13	99		COE
	Little Goose Extended Submerged Bar Screens	14	14	94		COE
		14	14	96		COE
	Lower Granite Extended Submerged Bar Screens	15	15	97		COE
		15	15	94		COE
	Lower Monumental Extended Submerged Bar Screens	16	16	94		COE
		16	16	78		COE
		16	16	99		COE
	McNary Extended Submerged Bar Screens	17	17	96		COE
		17	17	74		COE
	Lower Snake River Juvenile Bypass System Improvements	18	18	53		COE
		18	18	94		COE
	Multiple Bypass Accumulative Impacts	19	19			COE
	Separator Evaluation	20	20	95		COE
		20	20	81		COE
		20	20	53		COE
	Juvenile Salmon Temperature Studies	21	21	142		COE
		21	21	143		COE
		21	21	105		COE
		21	21	199		COE
		21	21	141		COE
	Evaluation of Transportation Strategies	22	22	52		COE
		22	22	47		COE
		22	22	49		COE
	Turbine Passage Survival Program	23	23	93		COE
		23	23	89		COE
		23	23	90		COE
		23	23	111		COE
		23	23	59		COE

CategoryType	ProjectTitle	Project ID	Hydro ID	NMFS Action	FWS Action	Lead Agency
SYSTEM CONFIGURATION	Turbine Passage Survival Program	23	23	91		COE
		23	23	64		COE
		23	23	88		COE
	Lower Granite Juvenile Bypass System	24	24	81		COE
	Lower Monumental Juvenile Bypass System Outfall	25	25	76		COE
	Little Goose Pit-Tag System Modification	26	26	53		COE
		26	26	94		COE
		26	26	87		COE
	McNary Cylindrical Dewatering Prototype Evaluations	27	27	94		COE
		27	27	74		COE
		27	27	146		COE
		27	27			COE
	McNary Juvenile Fish Facility Debris	28	28	74		COE
	Little Goose Trash Boom	29	29	79		COE
	Ice Harbor Spillway Survival Study	30	30	82		COE
		30	30	83		COE
	McNary Spillway Survival Study	31	31	82		COE
		31	31	83		COE
	Dalles Project Survival Study	32	32	69		COE
	Lower Monumental Gas Fast Track Deflectors	33	33	135		COE
		33	33	134		COE
		33	33	76		COE
	Little Goose Gas Fast Track Deflectors	34	34	134		COE
		34	34	135		COE
	McNary Gas Fast Track Deflectors	35	35	135		COE
		35	35	134		COE
	John Day Extended Length Screens	36	36	98		COE
		36	36	73		COE
		36	36	146		COE
	McNary outfall evaluation	37	37	74		COE

CategoryType	ProjectTitle	Project ID	Hydro ID	NMFS Action	FWS Action	Lead Agency
SYSTEM CONFIGURATION	The Dalles Sluice Outfall and Auxiliary Adult Water Supply	38	38	122		COE
		38	38	70		COE
	The Dalles Adult Entrance Channel Dewatering Modifications	39	39	123		COE
	McNary/Ice Harbor Adult Fallback Project	40	40	112		COE
	Bonneville Adult Fallback	41	41	113		COE
		41	41	60		COE
	Bonneville 2nd Powerhouse Adult Fishway Auxiliary Water Supply	42	42	120		COE
		42	42	127		COE
	John Day North Shore - Adult Fishway Auxiliary Water Supply	43	43	128		COE
	John Day Salmonid Holding and Jumping Project	44	44	110		COE
		44	44	116		COE
	John Day Ladder Temperature Project	45	45	114		COE
	Lower Granite Adult Fishway Auxiliary Water Supply Project	46	46	129		COE
	Lower Monumental Adult Fishway Auxiliary Water Supply Project	47	47	129		COE
	Little Goose Adult Fishway Auxiliary Water Supply Project	48	48	129		COE
	Ice Harbor Adult Fishway Auxiliary Water Supply Project	49	49	129		COE
	Adult Pit Tag Monitoring @ Bonneville, The Dalles , and John Day	50	50	50		COE
		50	50	192		COE
	McNary Adult Pit Tag Program	51	51	50		COE
	Adult Upstream Migration Studies	52	52			COE
	Kelt Studies	53	53	109		COE
	Fish Ladder Temperature Evaluation	54	54	114		COE
	Adult Temperature Evaluation	55	55	116		COE
		55	55	34		COE
		55	55	114		COE
		55	55	115		COE
	Adult Fish Transition Pool Evaluations	56	56	116		COE

CategoryType	ProjectTitle	Project ID	Hydro ID	NMFS Action	FWS Action	Lead Agency
SYSTEM CONFIGURATION	Adult Lamprey Passage	57	57	119		COE
	Marine mammal predation @Bonneville tailrace	58	58	106		COE
	Investigate adult headburn	59	59	108		COE
	Adult PIT tag monitoring- Snake River projects	60	60	90		COE
	Bonneville Gas Fast Track	72	72	134		COE
	The Dallles Gas Fast Track	73	73	134		COE
	John Day Spill/Survival Studies	74	74	82		COE
		74	74	83		COE
		74	74	71		COE
	John Day Surface Bypass/Removable Spillway Weir/Flow Deflectors	75	75	140		COE
		75	75	86		COE
		75	75	134		COE
		75	75	35		COE
		75	75	98		COE
		75	75	72		COE
		75	75	138		COE
	Modify water supply to the Dworshak NFH while maintaining discharges of Dworshak cold water	78	78	33		COE
	Investigate attraction of listed fish into wasteways from the Columbia Basin Project	81	81	37		BOR
	BOR shall install screens at the canal intakes to Burbank #2 and #3 pump plants.	82	82	38		BOR
	Investigate water quality of each point of return flows from the Columbia Basin Project	83	83	39		BOR
	Investigate surface bypass RWSW at McNary Dam & install the unit in multiple spillways as warranted	84	84	75		COE
	Investigate surface bypass RWSW at Lower Monumental Dam and install the unit in multiple spillways	85	85	77		COE
	Consider turbine design technology to decrease fish injury at The Dalles & Ice Harbor	86	86	92		COE

CategoryType	ProjectTitle	Project ID	Hydro ID	NMFS Action	FWS Action	Lead Agency
SYSTEM CONFIGURATION	Salmonid predation studies as required	87	87	104		BPA
		87	87	100		BPA
		87	87	103		BPA
		87	87	102		BPA
		87	87	101		BPA
	COE to develop and construct spillway deflectors at Chief Joseph Dam to minimize TDG.	88	88	136		COE
	Investigate TDG abatement at Libby Dam and installation of spillway deflectors /additional turbines	89	89	137		COE
	By January 2003, develop an analysis on ESBS's vs. RSW's at Lower Monumental	526	91	99		COE

CategoryType	ProjectTitle	Project ID	Hydro ID	NMFS Action	FWS Action	Lead Agency	
WATER MANAGEMENT	Annual Water Management Plan (1-WMP)	63	63	41		COE	
		63	63	3		COE	
		63	63	54		COE	
		63	63	43		COE	
		63	63	14		COE	
		63	63	19		COE	
		63	63	17		COE	
		63	63	16		COE	
		63	63	24		COE	
		63	63	18		COE	
		63	63	53		COE	
		63	63	26		COE	
		63	63	25		COE	
		63	63	15		COE	
		63	63	21		COE	
		63	63	20		COE	
		63	63	40		COE	
		63	63	58		COE	
		63	63	42		COE	
	Five-Year Water Management Plan (5-WMP)	64	64			COE	* Shared Lead
		64	64			PM	* Shared Lead
		64	64			BLM	* Shared Lead
	BOR Water Conservation Improvements	65	65	28		BOR	
	Report on Unauthorized Use of BOR Water	66	66	29		BOR	
	Water Acquisition from Reclamation’s Upper Snake River Basin Projects	67	67	32		BOR	
	Banks Lake Drawdown Study	68	68	31		BOR	
	VARQ Flood Control Operation	69	69	22		COE	* Shared Lead
		69	69	22		BOR	* Shared Lead
	Agreements for uncontracted water or storage space at Bureau reservoirs	76	76	27		BOR	

CategoryType	ProjectTitle	Project ID	Hydro ID	NMFS Action	FWS Action	Lead Agency	
WATER MANAGEMENT	Site specific consultations for BOR projects located downstream from Chief Joseph Dam	77	77	30		BOR	
	Feasibilty analysis of flood operations to benefit Columbia River ecosystem and salmon.	79	79	35		COE	
	Develop, and implement a revised storage plan for Libby reservoir	80	80	36		COE	
	Ensure that Hungry Horse refills in a timely manner without spill that causes excessive TDG	527	92	19		BOR	
	Annual Report on Treaty Canadian Water Storage	528	93	24		BPA	* Shared Lead
		528	93	24		COE	* Shared Lead
	Annual Report on Non-Treaty Canadian Water Storage	529	94	25		BPA	* Shared Lead
		529	94	25		COE	* Shared Lead
	Annual Report Additional Canadian Water Storage and Shaping	530	95	26		BPA	* Shared Lead
		530	95	26		COE	* Shared Lead
WATER QUALITY	Water Quality Plan, 1-Year	70	70	132		COE	
		70	70			COE	
		70	70	19		COE	
		70	70	5		COE	
		70	70	130		COE	
		70	70	131		COE	
	Water Quality Plan, 5-Year	71	71	133		COE	
		71	71	19		COE	
		71	71	5		COE	

CategoryType	ProjectTitle	Project ID	Hydro ID	NMFS Action	FWS Action	Lead Agency
OPERATIONS & MAINTENANCE	Fish Passage Plan (FPP)	61	61	144		COE
		61	61	6		COE
		61	61	58		COE
		61	61	11		COE
	One and Five-Year Operations and Maintenance Plan and Budget	62	62	146		COE
		62	62	145		COE
		62	62	6		COE
		62	62	121		COE
	COE to investigate TDG abatement at Dworshak Dam and implement options as warranted.	90	90	139		COE
	Columbia Falls Reinforcement	531	96	56		BPA
	Schultz-Hanford Transmission Reinforcement	532	97	55		BPA
	West Of Hatwaii Transmission Reinforcement	533	98	56		BPA
	Report on new non-hydro generation resources	534	99	57		BPA
	Water Quality Effects on Bull Trout Survival Near Hydro-projects	535	100		FWS10.A.3(1)	COE
	Juvenile Salmon Transportation Evaluations	536	101	185		COE
		536	101	191		COE
		536	101	195		COE
		536	101	46		COE
		536	101	45		COE
		536	101	181		COE
		536	101	182		COE
		536	101	52		COE
		536	101	49		COE
		536	101	47		COE
	Bull Trout Distribution, Timing, and Usage of the Lower Snake River Reservoirs	537	102		FWS10.A.3(1)	COE
	Dworshak Reservoir Bull Trout Distribution to North Fork of the Clearwater River	538	103		FWS10.A.3(2)	COE

II. System Configuration Projects

Overview

Much attention has been given over the last decade to improving juvenile and adult passage through the complex hydro system facilities. Turbine designs and operations today enable 40-60 percent of Snake River spring/summer smolts to survive inriver migration through the hydro system compared with an estimated system survival rate of 5-40 percent in the 1970's. Most of the improvements to the dams and their associated fish facilities have been made through a program referred to as Columbia River Fish Mitigation (CRFM) program. Congressional appropriations are approved each year through the congressional budget cycle and vary from year-to-year. BPA power revenues reimburse to the COE for capital improvements. Each fall, after the appropriations packages pass Congress, an organization known as the SCT, made up of State, Tribal, and Federal representatives, prioritizes proposed projects for funding.

There are three ways for downstream migrants to pass the dams. They may enter bypass systems and be carried through the bypass system to the downstream pool, they may pass over the spillway, or they may pass through the turbines. Configuration actions are focused on improving survival in each of these passageways as well as increasing non-turbine passage. Bypass systems route downstream migrants away from the turbines.

Adults returning to spawn are routed into fish ladders, which allow the fish swim past the dam, and into the pool above. The configuration program also contains a number of fish ladder improvements that are designed to help adults circumvent the dams more quickly and to avoid falling back over the dam through the spillways and turbines.

Configuration projects also are directing at reducing gas saturation by shaping and modifying the spillways. These projects are termed gas fast-track projects.

Project Management Plans - Configuration Projects

Work plans for configuration projects that are planned in response to the NMFS Biological Opinion are enclosed as the following pages. Most configuration projects will take several years to complete and thus estimated costs are shown in each year that work is planned.

Configuration projects within the Hydro Actions Table have not yet been prioritized (High, Medium or Low Priority) so the schedules assume that all of the projects will begin as soon as possible. Budget limitations or research needs may cause the schedule for some of these projects to shift when the prioritization is complete.

1. Bonneville Automated Trashrakes

Multi-Year Plan

1. Project Information

- **Purpose/Objective:** The purpose of the program is to automate trashrack cleaning at FV3-9 and FV5-9 to meet current fishway operation criteria. Manual cleaning can only be performed after closure of the valves, thereby reducing collection channel flow to almost nothing. This results in a ladder operation which is a violation of the Fish Passage Plan.

- **Description:** Automated rakes can be designed and installed that will allow cleaning of the trashrack face without closing the valves, thus keeping the ladder in criteria at all times.

2. Major Activities/Tasks: A contract was awarded in 2001 for the design and installation of an automated trashrake at The Dalles. The contract has optional bid items that can be exercised for the design and installation of automated trashrakes at Bonneville FY3-9 and FV5-9.

Milestone	Date (Mo/Yr)
Award Optional Bid Items for Bonneville Trashrakes	Jun/01
Complete Design and Installation of Bonneville Trashrakes	Feb/02

3. Cost Estimate:

Activity	FY02	FY03	FY04	FY05	FY06
Design and Install Trashrakes	280				
TOTALS	**280**				

4. Issues: The above plan assumes that $200K is available in 2001 to begin the design work, otherwise, the work can not be completed in 2002.

5. RPA Action: Biological Opinion measure No. 146. "The Corps shall address debris handling needs and continue to assess more efficient techniques to ensure the performance of both old and new fish passage facilities."

2. The Dalles Surface Bypass Studies

DRAFT Multi-Year Plan
8 March, 2001

1. Project Information:

- **Purpose/Objective:** The long- term purpose of this measure is to investigate and evaluate surface bypass technology at The Dalles project. The ultimate program includes collection of biological behavior field data, hydraulic model testing of various surface bypass alternatives and development and testing of prototype surface collectors. Installation of a screened bypass system is currently shelved, pending the outcome of the surface bypass studies.

  The current policy to utilize the spillway at The Dalles as the primary method to bypass juvenile fish has resulted in reduced emphasis and deferral of development of a powerhouse surface collector prototype. However, significant numbers of juveniles pass the project via the ice and trash sluiceway, which functions as a relatively small-scale surface collection system (about 4500 cfs).

  In 1998, field test data indicated the sluiceway passed about 25 percent of total project passage (both spring and summer) at a 64 percent spill rate. At a 30 percent spill rate the sluiceway passed 51 percent of spring fish and 44 percent of summer fish. Survival rates experienced through the sluiceway were 96 percent for spring and 89 percent for summer fish, at the 30 percent spill rate.

  In 1999, hydroacoustic data indicated a sluiceway passage efficiency of 12 percent at the 64 percent spill rate and 15 percent at the 30 percent spill rate. Radiotelemetry data for spring fish indicated sluiceway passage rates were 9-12 percent at the 64 percent spill rate and 21-25 percent at the 30 percent spill rate.

  In 2000, the sluiceway passed 6 percent of spring and 11 percent of summer juveniles at a 40 percent spill rate. The survival rate was 95 percent for spring and 89 percent for summer juveniles.

  The primary objective of this measure is to reduce turbine entrainment of juvenile fish by diverting them to either the spillway or sluiceway passage routes.

- **Description:** Since the sluiceway relocation measure would function as a reduced scope surface bypass system for The Dalles, efforts are underway to test prototype turbine intake trashrack blocks to reduce turbine entrainment and increase sluiceway and spillway passage efficiencies. Previous trashrack block test data was inconclusive. "J" shape trashrack block prototypes are planned to be tested at The Dalles in 2001, and likely again in 2002. Initiation of a "permanent" design was also initiated in 2001.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete 2001 "J" shape surface guidance device field test	Aug, 2001
Complete Design Report for permanent installation (full powerhouse)	Oct, 2001
Complete 2002 "J" shape surface guidance device field test	Aug, 2002
Complete P&S for permanent "J" installation	Oct, 2002
Start Construction permanent "J" installation	Dec, 2002
Complete Construction permanent "J" installation	Apr, 2004

3. Cost Estimate ($millions)

Activity	FY02	FY03	FY04	FY05	FY06
Studies & Design	1.4	0.4	0.3	0.1	
Biological Testing	2.5	0.5	2.0	0.3	
Construction	-	4.0	4.0		
Other	0.1	0.4	0.4	0.1	
Contingencies	-	1.0	1.0		
TOTAL	4.0	6.3	7.7	0.5	

4. **Issues:** Design and testing of a large scale prototype powerhouse surface collector is on hold, pending decisions regarding continuance of utilizing spill as the primary method to pass juveniles at The Dalles and potential installation of permanent trashrack blocks and relocation of the ice and trash sluiceway outfall.

5. **RPA Action: 69**

The Dalles Project Survival Study

DRAFT Multi-Year Plan
8 March, 2001

1. Project Information

- **Purpose/Objective:** The purpose of survival studies at The Dalles Dam is to determine the best project configuration for fish passage. An important element of this program will be to ascertain whether survival improvements can be achieved through spillway, stilling basin, and turbine modifications.

- **Description:** The current juvenile fish passage strategy for The Dalles Dam is to maximize fish passage through the spillway and Ice and Trash Sluiceway. Recent fish passage efficiency evaluations suggests that the spillway is highly effective at passing a large proportion of the juvenile run: at 40 percent juvenile spill it is estimated 77 percent to 85 percent of the run passes the dam via the spillway. Under this same operation, an additional 6 percent to 11 percent of the run passes via the sluiceway.

  Since 1996, survival tests have been conducted at The Dalles Dam. Early tests suggested that spillway survival was lower than expected, and later tests determined that percentage of spill affects survival, with 30 percent spill resulting in higher survival than 64 percent spill. As a result of these findings, regional salmon managers have reduced the percent spill from 64 percent to 40 percent. Spillway survival, while improved at 30-40 percent compared to 64 percent, is still unacceptably low for a primary passage route, however. In addition to spillway survival, turbine and sluiceway survival has been tested. Turbine survival rates were much lower than expected, based on estimates from other dams. Sluiceway survival rates varied by year and season, with unacceptably low survival (89 percent) tested in the summer of 1998.

  Previous evaluations attempted to measure survival improvements under various spill levels. These tests did not enable us to identify mechanisms for observed mortality (e.g. predation or mechanical injury). The next important step to take is to determine whether survival rates at The Dalles Dam can be improved through spillway, sluiceway and turbine unit modifications. The scope of survival studies has shifted from developing point survival estimates under various operating conditions, to identifying mechanisms for mortality. This information will be used to guide spillway and sluiceway modifications and turbine rehab decisions. The survival study program is tentatively extended four years, with final report in 2006, however is heavily dependent on the annual test results.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete 2001 Field Testing	Jul 2001
Complete 2001 Draft Final FPE Analysis	Mar 2002
Complete Report	May 2002
Complete 2002 Field Testing	Jul 2002
Complete Reports	May 2003
Complete 2003 Field Testing	Jul 2003
Complete Reports	May 2004
Complete 2004 Field Testing	Jul 2004
Complete Reports	May 2005
Complete 2005 Field Testing	Jul 2005
Complete Report	May 2006

3. Cost Estimate ($millions)

Activity	FY02	FY03	FY04	FY05	FY06
Survival Analysis & Report	2.5	2.5	2.5	2.5	0.3

4. Issues: Reduced spill rates at The Dalles apparently results in increased numbers of juveniles which utilize the turbine and sluiceway passage routes, thus increasing the importance of fully understanding and resolving survival concerns via those routes.

Spillway deflectors are being investigated under a separate program intended to result in reducing gas levels at The Dalles. Due to relative shallow and turbulent stilling basin conditions at The Dalles, deflectors may also contribute to decreased direct juvenile mortality, however, may also result in higher numbers of juveniles being swept into the Bridge Islands, located immediately downstream of the spillway. Deflectors and could also jeopardize potential benefits of the sluiceway outfall relocation measure.

5. RPA Action # 68, 82, 83, 86

The Dalles Sluice Outfall & Auxiliary Adult Water Supply

DRAFT Multi-Year Plan
8 March, 2001

1. Project Information

- **Purpose/Objective:** The purpose of this measure is twofold:
  1) To provide an emergency water supply for adult fish attraction along the powerhouse and south end of the spillway should one of the two existing fish water turbine units fail.
  2) To relocate the ice and trash sluiceway outfall to a location less prone to juvenile predation.

- **Description:** The existing fish units are both required to run simultaneously to provide approximately 4200 cfs adult attraction water, required for the Oregon side fish ladders.

  An adult attraction backup water supply alternative analysis was completed in 1997, with installation of a pump system recommended, at an estimated total cost of approximately $33 million. A separate study to evaluate the feasibility to relocate the ice and trash sluiceway outfall to a location less prone to juvenile predation was also completed in 1997, under The Dalles Surface Bypass Study. A subsequent third study concluded significant savings could be realized if the two measures were combined for economy, utilizing a dewatering system in a relocated sluiceway channel to provide the backup adult water supply.

  Development of a Detailed Design Report (DDR), including a more detailed design and cost estimate for the combined system, is scheduled for completion by May 2001; however, the outfall site previously selected for detailed development in the DDR has recently been determined unsatisfactory based on extensive hydraulic model studies. Initiation of Plans and Specs for construction of the project will be delayed, pending completion of a reanalysis of potential outfall locations and completion of the DDR. Consideration will now also be given to the impact on the outfall site of possible future installation of spillway flow deflectors.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete Alternate Sluice Outfall Site Reanalysis	Oct , 2001
Complete Detailed Design Report	Sep, 2002
Complete P&S for Outfall Relocation	Feb, 2004
Start Construction Outfall Relocation	Jul, 2004
Complete Construction Outfall Relocation	Apr, 2006

3. Cost Estimate ($millions)

Activity	FY02	FY03	FY04	FY05	FY06
Studies & Design	2.5	3.0	0.4	0.3	0.2
Biological Testing					2.0
Construction			5.0	15.0	10.0
Other	0.1	0.1	0.5	1.2	0.8
Contingency				3.0	2.0
TOTAL	2.6	3.1	5.9	19.5	15.0

4. Issues

Several factors will need to be taken into consideration to determine the relative merits of this measure, including the impact on a selected outfall relocation site of possible spillway deflectors, spill pattern future spill volume, anticipated sluiceway juvenile passage efficiency, anticipated predation control success in the tailrace, and cost. The above construction cost is based on the current design developed in the DDR.

5. RPA Action: 70, 122

The Dalles Adult Entrance Channel Dewatering Mods

DRAFT Multi-Year Plan
8 March, 2001

1. Project Information

- **Purpose/Objective**

The purpose of this item is to provide a dewatering system for the lower portions of the fishladder entrances and transportation conduit at the south shore fish ladders at The Dalles dam to allow inspection and maintenance to be performed under dewatered conditions. Previous attempts to dewater the system were unsuccessful, primarily due to high leakage through numerous stoplogs that were intended to seal the system. Discovery of damaged underwater screens within the adult entrance conduit at The Dalles reinforced the need for improvements which would allow safe inspection and maintenance of the adult passage system.

- **Description**

Plans and specifications are currently being developed. The stoplogs would be re-sealed with an improved seal design and additional pumping capacity provided for dewatering the adult transportation system.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete P&S for Adult Channel Dewatering Mods	Aug, 2001
Start construction contract	Dec, 2001
Complete construction	Mar, 2004

3. Cost Estimate ($millions)

Activity	FY02	FY03	FY04	FY05	FY06
Design	0.1	0.1	0.1		
Construction Contract	1.0	1.8	1.7		
Other	0.5	0.2	0.2		
Contingency	0.3	0.6	0.6		
TOTAL	1.9	2.7	2.6		

4. Issues

Construction is assumed to require two in-water work periods, however if removal and repair of the downstream stoplogs can be performed continuously, the construction time could likely be significantly reduced.

5. RPA Action: 123

3. Bonneville 2nd Powerhouse JBS Improvements

DRAFT Multi-Year Plan
February, 2001

1. Project Information

- **Purpose/Objective** The purpose of the JBS improvements is to modify flow conditions in the collection channel, construct a dewatering system that meets current criteria for flow through the screens, relocate the outfall to a location approximately two miles downstream of the powerhouse to minimize predation, and provide a juvenile fish monitoring facility. The collection channel improvements and outfall relocation were completed in 1999, with the monitoring facility completed in 2000. Minor modifications to the system are required to ensure effective passage and will be completed through follow-on contracts.

- **Description** Follow-on work consists of improvements in the secondary dewatering system at the monitoring facility, modifications to the switchgate to ensure fry are not injured or killed, addition of a new PIT-tag detector, provisions for splash guards on the grating in the collection channel, and other modifications. Post-construction monitoring of the system after 2000 is included in the juvenile fish passage studies measure, so no additional AFEP studies are included in this measure.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete PDS/SDS modifications and new Pit-tag detector	April 2001
Complete sun-shades for electrical panels and drainage modifications	September 2001
Complete construction of gate behind switchgate if required	March 2002

3. Cost Estimate

Activity	FY02	FY03	FY04	FY05	FY06
Complete follow-on work	750				

4. Issues The cost estimate assumes we will need to add a vertical lift gate behind the switchgates to ensure fry are not injured. It is a placeholder estimate, pending final scoping. We have attempted to identify all required fixes. However, there is the potential for additional items to be added as the system is operated in 2001 with the changes made to date.

5. RPA Action 65 The Corps shall complete Bonneville Second Powerhouse post-construction evaluation of the new juvenile fish bypass outfall and address design and operational refinements as warranted.

4. Bonneville 1st Powerhouse JBS Improvements

DRAFT Multi-Year Plan
February, 2001

1. Project Information

- **Purpose/Objective** The purpose of the JBS improvements is to modify flow conditions in the collection channel, construct a dewatering facility that meets current criteria for flow through the screens, relocate the outfall to the recently completed structure on the Washington shore, and add juvenile fish monitoring capability inside the building housing the 2nd powerhouse facility near the outfall.

- **Description** Plans and specifications will be completed in 2001. A decision between implementing JBS improvements, and potentially extended length screens, versus continued evaluation of surface bypass technology is scheduled to occur no later than January 2002, but could be made as early as March 2001. If implemented, additional orifices would be added in the powerhouse, which coupled with collection channel modifications, will decrease holding and injury in the bypass system. A new dewatering facility would be constructed outside the powerhouse, with an elevated flume bridging across the river to tie into a previously placed buried flume on the Washington shore. Adding monitoring capability for B1 would be performed by separate contract. Due to the impacts of the collection channel modifications, the ice and trash sluiceway will no longer provide debris-sluicing capability. Therefore, we would also construct and install a trash boom in the forebay. Potential extended length screen implementation is covered in the 1st powerhouse FGE improvements measure. AFEP studies for post-construction monitoring are included.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete plans and specifications	March 01
Advertise (pending regional decision)	March 01
Complete construction	March 03
Complete post-construction M & E	December 05

3. Cost Estimate

Activity	FY02	FY03	FY04	FY05	FY06
Construction/Admin	36000	32000			
Post-construction M & E			900	500	

4. Issues The funding schedule shows an assumption that we will initiate construction in 2001. If this does not occur, approximately $5 million would need to be added to the funding stream in 2002, with a delay in the shown funding levels of 1 year.

5. RPA Action 97 By January 2002, the Action Agencies shall develop an analysis that compares the relative passage survival benefits of an extended-length, intake screen bypass system, a surface collection system, and hybrid alternatives at Bonneville First Powerhouse. The decision on which alternative may be made as early as January 2001, but no later than January 2002.

RPA Action 63 The Corps shall complete the design of debris removal facilities for the Bonneville First Powerhouse forebay.

5. Bonneville 2nd Powerhouse Gatewell Debris Removal

DRAFT Multi-Year Plan
February, 2001

1. Project Information

- **Purpose/Objective** The purpose of this measure is to evaluate a debris channel tying into the ice and trash sluice chute to remove debris from the gatewell in units 11 and 12. The schedule assumes this work will occur after completion of the 2nd Powerhouse corner collector in 2004.

- **Description** An automatic valve would allow debris and flow to enter an open channel flume and travel through a powerhouse wall into the ice and trash chute.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Finalize P & S	June 2003
Contract Award	September 2003
Complete Construction	March 2005

3. Cost Estimate

Activity	FY02	FY03	FY04	FY05	FY06
Construction/Admin		50	650	725	TBD

4. Issues Following completion in 2005, an assessment would be made to determine if additional units require debris sluicing capability.

5. RPA Action 146 The Corps shall address debris-handling needs and continue to assess more efficient and effective debris-handling techniques to ensure that performance of both new and old fish passage facilities will not be compromised.

6. Bonneville 2nd Powerhouse Surface Bypass (Corner Collector)

DRAFT Multi-Year Plan
February, 2001

1. Project Information

- **Purpose/Objective** The purpose of this measure is to increase project survival through high flow (approximately 5,000 CFS) surface bypass at the existing ice and trash sluice chute at the 2nd powerhouse. Biological studies conducted in 1998 show that significant numbers of juveniles entered the trash chute with flows slightly higher than 2,000 CFS. The existing chute outfall cannot handle large flow volumes without eroding the shoreline. In addition the plume is not in an optimal location to ensure juvenile survival. Therefore a new outfall location is required.

- **Description** The major components of the measure include lowering the existing upstream gate in the forebay to allow for increased flows into the sluice chute, construction of an ogee inside the chute to create conditions conducive to safe juvenile passage, and construction of a new outfall structure. A site selection report will be completed in 2001, followed by a DDR, plans and specifications, and construction. An adjustable cantilever is assumed to be the outfall type selected. Two outfall locations are currently being considered. One approximately 400' downstream of the current ice and trash chute exit, and another, at the tip of Cascades Island. No plunge pool is required with the adjustable cantilever. Two years of post-construction monitoring in 2004 and 2005 is included.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Verify High Flow Outfall Guidelines	April 2001
Determine Outfall Site and Type	April 2001
Initiate DDR	February 2001
Complete DDR	October 2001
Initiate Plans and Specifications	June 2001
Advertise	April 2002
Award	July 2002
Complete Construction	March 2004
Complete Post-Construction Monitoring	December 2005

3. Cost Estimate

Activity	FY02	FY03	FY04	FY05	FY06
	3000	12000	9000	1000	200

4. Issues The cost estimate shown assumes selection of an adjustable cantilever outfall type at a range approximately 400' downstream of the existing ice and trash chute outlet. The cost estimate is based on preliminary engineering work done to date, and will be updated in 2001 as the first design document is completed. Another outfall location is still under consideration, which would increase the project cost estimate to approximately $75 million if the other range is not acceptable.

Implementation of this measure will eliminate the trash chute as a source of emergency AWS water for the adult ladder. Potential new methods are being studies by separate measure.

5. **RPA Action 66** The Corps shall continue design development and construction of a Bonneville Second Powerhouse permanent corner collector at the existing sluice chute, pending results of high flow outfall investigations. The Corps shall construct new facilities if, and as soon as, evaluations confirm the optimum design configuration and survival benefits.

   RPA Action 84 The Corps shall continue high-flow outfall investigations to determine whether it is appropriate to modify bypass outfall criteria in the context of high-discharge bypass discharges.

   RPA Action 86 The Corps shall continue to investigate a way to increase entry rates of fish approaching surface bypass/collector entrances.

7. Bonneville 1st Powerhouse Surface Bypass (Deep Slot)

DRAFT Multi-Year Plan
February, 2001

1. Project Information

- **Purpose/Objective** The purpose of this measure is to evaluate the potential success for surface bypass technology to effectively pass fish at the 1st powerhouse, and compare this system with an extended length screened bypass system. The measure includes all engineering, hydraulic, and biological studies required to evaluate surface bypass technology. The measure also includes the cost to construct prototype structures for biological field evaluations. The current focus is on a deep slot collector across the face of the powerhouse. Two potential paths are shown. Path one assumes that the 2001 decision will show that additional prototype evaluations are justified. Path two assumes that the 2001 decision will determine that additional studies are not warranted, and the prototype structures will be removed from the face of the powerhouse.

- **Description** A four-unit deep slot prototype (PSC) was constructed in front of units 3 – 6 in 1998 without a collection channel. Bypassed juveniles were able to pass through the back of the collector into either the existing screen bypass system or into the turbines. Due to some concerns with fish behavior in front of units 3 and 4, additional prototype structures were installed in front of units 1 and 2 for testing in 2000. If additional studies are conducted, we will evaluate and determine slot width and system performance with a ramp into a collection channel before making an implementation decision. The costs shown below for this measure include the costs to prepare the Bonneville Decision Document.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete Bonneville Decision Document	March 2001
Path 1	**TBD**
Evaluate Slot Width with Existing Prototype	2002
Evaluate New Prototype with Ramp	2004 - 2006
Full Implementation Complete	March 2010- 2013
Path 2	**TBD**
Complete Letter Report to Evaluate PSC Removal	September 2001
Initiate Plans and Specifications for PSC Removal	October 2001
Advertise Contract	June 2002
Complete PSC Removal & Completion of Surface Bypass Study	March 2003

3. Cost Estimate

Activity	FY02	FY03	FY04	FY05	FY06
Path 1	3500	3300	9300	3800	5200
Path 2	1500	5000			

4. Issues A general plan for continued deep-slot prototype development has been prepared for input into the decision document. This is the basis of the schedule and cost estimate provided for path one. If the decision is

made to pursue further prototype development, this plan will be reviewed regionally prior to beginning detailed design of the next prototype structure. Note, that actual implementation is expected to occur between 2010 and 2013. Therefore, not all funding requirements are displayed. The cost and schedule shown for path two are placeholders, pending actual scoping if the decision is made not to pursue further deep-slot prototype development.

5. **RPA Action 61** The Corps shall complete the ongoing prototype powerhouse system surface collection evaluation at Bonneville First Powerhouse in 2000. The Corps shall compare the prototype with screened bypass systems, and if warranted, design and construct permanent facilities after full consideration and resolution of biological and engineering uncertainties, especially high flow outfall evaluations.

RPA Action 86 The Corps shall continue to investigate a way to increase entry rates of fish approaching surface bypass/collector entrances.

RPA Action 97 By January 2002, the Action Agencies shall develop an analysis that compares the relative passage survival benefits of an extended-length, intake screen bypass system, a surface collection system, and hybrid alternatives at Bonneville First Powerhouse. The decision on which alternative may be made as early as January 2001, but no later than January 2002.

8. Bonneville 1st Powerhouse FGE Improvements

DRAFT Multi-Year Plan
February, 2001

1. Project Information

- **Purpose/Objective** The purpose of this measure is to evaluate potential actions to improve the fish guidance efficiency (FGE) of the screened bypass system at the 1st powerhouse. The main focus of the evaluation is extended length bar screens (ESBS), streamlined trashracks, modifications to the vertical barrier screens (VBS), and adding a turning vane to increase flow up the gateslot. Prototype structures were evaluated in 1998 and 2000. In addition, biological studies focused on fish behavior in front of the trashracks to evaluate whether or not prototype evaluations of relocated trashracks might have merit to increase guidance.

- **Description** If the decision document recommends installation of ESBS and associated components, a letter report for full powerhouse installation would be prepared. Preparation of plans and specifications, and construction of permanent structures would follow this. Handling requirements for the ESBS are already covered through separate funding of a new intake crane. One year of post-construction monitoring is included.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Initiate Letter Report for full Implementation	04/01
Initiate Plans and Specifications	07/01
Initiate Construction	05/02
1st Delivery & Installation Complete	03/03
Complete Installation	03/04
Complete Post-Construction Monitoring	12/04

3. Cost Estimate

Activity	FY02	FY03	FY04	FY05	FY06
	3000	10000	10000	100	

4. Issues The cost estimate and schedule assumes that we will not pursue prototype testing of relocated trashracks due to behavioral information from 2000 prototype tests. In addition, the VBS and ESBS bar spacing do not meet fry criteria. If this is required, approximately three years and additional funding would be required to construct new prototype structures and perform biological testing prior to installation. If the decision to implement is not made in 2001, additional funding of approximately $500,000 would be required in 2001, and implementation and funding shown above would be delayed one year. The cost estimate is based on information developed for the ongoing decision document. If the decision process selects ESBS for implementation, we will update the cost estimate in a letter report for full powerhouse installation.

5. RPA Action 62 The Corps shall complete Bonneville First Powerhouse prototype evaluations of extended submerged bar screens and gatewell vertical barrier screens, including an assessment of fry passage.

RPA Action 97 By January 2002, the Action Agencies shall develop an analysis that compares the relative passage survival benefits of an extended-length, intake screen bypass system, a surface collection system, and

hybrid alternatives at Bonneville First Powerhouse. The decision on which alternative may be made as early as January 2001, but no later than January 2002.

9. Bonneville 2nd Powerhouse FGE Improvements

DRAFT Multi-Year Plan
February, 2001

1. Project Information

- **Purpose/Objective** The purpose of this measure is to evaluate potential actions to improve guidance into the screened bypass system at the 2nd powerhouse. Improvements to the bypass system were completed in 1999, and results of evaluations conducted to date, show that fish are moving through the system with minimal delay and injury. A review of previous work to improve guidance in the 1980's was conducted to begin the study. This review recommended focusing on increased flow into the gatewell as the initial focus of the study. Other potential actions outside the trashracks could be considered in the future, depending upon results of the gatewell flow modifications. We are also focusing our efforts on actions that would not impact the effectiveness of the proposed corner collector at the south end of the powerhouse.

- **Description** Studies to date have shown that removing a portion of a beam to increase the size of the vertical barrier screen (VBS), providing perforated plate behind the VBS to balance the flow and reduce velocities through the VBS, provision of a turning vane, and a gap closure device significantly increase gatewell flow. Construction of prototype features on unit 15 will be complete in April 2001 for a prototype test. The test will evaluate guidance, and will also evaluate fish passage through the gap above the screen and below the intake ceiling with and without the gap closure device. Other potential actions include raising the operating gate and blocking the trashracks in various configurations. The cost estimate and schedule shown below assume that these additional features will not be evaluated in the field, and that the results of 2001 and 2002 prototype testing will be positive. The cost estimate does include minimal modifications for the 2002 test. The schedule and cost estimates are placeholders and have not been completely scoped.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Initiate Construction of Prototype Features for 2001 Test	01/01
Begin 2001 Evaluation	04/01
Make Decision on 2002 Prototype	07/01
Begin 2002 Evaluation	04/02
Initiate DDR for Implementation	01/03
Initiate Plans and Specifications	06/03
Initiate Construction	06/04
Complete Construction	03/05
Complete Post-Construction Monitoring	12/06

3. Cost Estimate

Activity	FY02	FY03	FY04	FY05	FY06
	2800	1000	4100	4000	1000

4. Issues The first year of biological testing will be initiated in April 2001. The schedule and cost presented assume the 2001 prototype configuration will be successful. The success of the 2001 evaluation, and the milestone shown to determine the 2002 prototype will be critical in determining our future course of action. The cost estimate shown is a placeholder, and will be updated in future design documents if these measures are selected for implementation.

5. **RPA Action 67** The Corps shall continue Bonneville Second Powerhouse investigations of measures to improve intake screen fish guidance efficiency and safe passage through the gatewell environment This work shall include an assessment of fry passage.

10. Bonneville Juvenile Fish Bypass Studies

DRAFT Multi-Year Plan
February, 2001

1. Project Information

- **Purpose/Objective** The purpose of this measure is to evaluate fish passage efficiency (FPE) and project survival at Bonneville Dam. This will aid in future decision-making regarding project operations and configuration. The measure also includes the cost for route specific survival estimates, including the new JBS system at the 2nd powerhouse and the spillway.

- **Description** A pilot test using radio tags to estimate project survival was initiated in 2000. Based on these results, project and route specific survival estimates are planned for 2001, 2002, and 2003. The tests in 2002 and 2003 will include a focus on comparing existing and planned new flow deflectors. The flow deflector measure will include a plan for funding direct mortality estimates through balloon tag testing. Hydroacoustics will also be used to evaluate fish passage. The resulting data will be analyzed in conjunction with project operations data. The costs are placeholders based on current estimates for 2001 studies.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Begin 2001 Evaluation	04/01
Begin 2002 Evaluation	04/02
Begin 2003 Evaluation	04/03
Complete 2003 Evaluation	12/03

3. Cost Estimate

Activity	FY02	FY03	FY04	FY05	FY06
	3000	3000	200		

4. Issues We have no issues at this time.

5. RPA Action 82 and 83 The Action Agencies, in coordination with NMFS through the annual planning process, shall investigate the spillway passage survival of juvenile salmonids at appropriate FCRPS dams.

11. Bonneville Flat Plate

DRAFT Multi-Year Plan
February, 2001

1. Project Information

- **Purpose/Objective** The purpose of this measure is to provide PIT-tag capability at the 1st powerhouse until a new bypass system or surface bypass system is implemented. A flat plate detection system has been installed at the powerhouse.

- **Description** A yearly placeholder for potential modifications to the system is included on an annual basis.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Determine if modifications are required for 02 passage season	10/01
Complete New JBS System at B1	03/03

3. Cost Estimate

Activity	FY02	FY03	FY04	FY05	FY06
	50				

4. Issues If the new JBS system at B1 is not implemented, or if it is delayed, additional modifications to the system may be required in the outyears.

5. RPA Action 87 The Corps and BPA shall assess less intrusive, PIT-tag interrogation methods at FCRPS juvenile bypass systems.

12. Delayed Mortality of Juveniles Salmonids With Different Migration Histories

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - Unexplained post-hydrosystem mortality has been described as the mortality that occurs above the rates observed in the historical data or above the expected rates based on the adults returns documented in similar systems. Speculation on the factors that may cause "extra mortality" have been attributed to unfavorable conditions in the estuary and ocean environments (often referred to as a regime shift), the viability of the stock, and a delayed detrimental effects of the hydrosystem on salmon survival. Overlapping the hydrosystem induced "extra mortality" is "delayed mortality", which has been expressed as the indirect mortality that occurs downstream of Bonneville (or following transportation) that can be attributed, specifically, to the operation, design or management of the hydrosystem. The definition of "delayed mortality" is usually expressed as the differences between the rates of post-system mortality that is dependent of the general route of passage through the hydrosystem (transportation, bypass facilities, spill/turbine passage) but with special emphasis on the difference in mortality compared to that of transported fish. Identifying the causes and their effects on "delayed mortality" for the specific salmon stocks and species for each route of passage through the hydrosystem will provide the critical post-hydrosystem performance criteria to which many of the items under the CRFM will be judged successful for the benefit of salmon.

  Results from previous transportation studies show that transported fish return at a higher rate than fish that are allowed to remain in river to complete their out migration. However, there appears to be a trend in the data that indicates transported salmon may have a higher rate of mortality after they leave the hydrosystem when compared to salmon that are not transported. This estimated "delayed mortality" appears to be highly variable depending on the year and season, however, since the rates of delayed mortality are not easily measured the causes of "delayed mortality" remain unidentified.

  Speculation as to the causes of "delayed mortality" have been attributed to several sources, such as the physiological changes in fish that reduce the ability of fish to be able to make the transition to the saltwater environment, to grow, avoid predators, or increases in the injury or exposure to diseases. Transportation, for example may alter the migration and schooling behavior of the smolts that make them more vulnerable to predators in the post-release environment. Or, the operation of the transportation program may release juvenile fish to the estuary too early in their life cycle to successfully enter the ocean or may release fish at a location that exposes them to extreme levels of predation.

  Part the Critical Risk Initiative identified the time period spent in the estuarine and early ocean life as one of the most critical periods in the life-cycle of salmon. Any increase in survival during this period of a salmon's life may offer some of the greatest recovery benefits. Thus, information on delayed mortality that leads to improvements to the changes transportation program or the management of the hydrosystem to increase the estuarine and early ocean survival will provide progress toward the regional effort to recover the ESA listed salmon.

- **Description** - This project attempts to provide more information on delayed mortality by reduce the variability in the current data sets and isolating the causes that contribute to long-term post-system mortality in effort to reduce this effect.

Product – Baseline Information:
Since documenting the causes of "delayed mortality" will be difficult, it has been suggested that a systematic approach be used to evaluate the mechanisms that control or influence the rates of "delayed mortality". This includes evaluations that overlap many other programs of the CRFM:

- Difference in long-term survival observed in groups of fish with known passage histories;
- Evaluation of the differences in the migration characteristics and behavior during their passage through the estuary and the Columbia River plume into the near-ocean environment;
- Comparison of the physiological, health, and nutritional differences that occur in fish that migrate through the various routes of passage that effect post-hydrosystem survival;
- Evaluation of the effects of current and proposed barging strategies (seasonal transportation, release location and timing) on post-release survival. (The operation of the transportation program is being re-evaluated to try and develop a barging strategy that is based on the utilization of information related to the physiological condition of fish and the operational processes that result in the release the fish downstream of Bonneville at the optimal time and location for the highest salmon survival.)
- Evaluate the direct effects of project operations and the flows controlled by Bonneville Dam on the immediate estuarine and Columbia River plume hydrograph. Not only does this include the effects of the chemical and physical environment but, also, influences on the migration characteristics of the salmon and the distribution, abundance and cycles of salmon predators.

2. Major Activities/Tasks -

a. Continue to review historical current data to assess the adult return rates of juvenile salmon that completed their outmigration through the various routes of passage through the hydrosystem.
   - Data Analysis – Part of ongoing adult passage evaluations

b. The direct approach of correlating differential survival of juveniles that have passed through these routes of passage is at best very difficult to obtain. Thus, a reduced approach is proposed to isolate the causes of differences in the rates of mortality. Fish with known passage histories (obtained through PIT tag detection and specific handling at the projects) will be collected and reared for a several months past their normal period of ocean entry, fish condition and mortality will be correlated to their route of passage.

   This work is under development and is tentatively proposed for the construction of a rearing facility at the Bonneville Dam juvenile bypass facilities. The first year of work shall involve design of the rearing facility, development of the collection and rearing and sampling protocol.

   Three sample groups are proposed, a single PIT tag detected group (to represent inriver passage), multiple PIT tag detection (multiple bypass group), and a barge transportation group. The methodology and designs for sampling a barged transportation group is still under development.

   Utilization of rearing to asses "delayed mortality" for this type comparative evaluation can provide an indication of the success or impact of an operation on survival without the typical, high level, of fish handling. Studies that have been impractical in the past can now be considered. Examples of these types of evaluations included a comparative trucking versus

inriver long-term survival study and survival evaluations for fish groups that experience multiple bypass passages in combination with being transported.

- Feasibility - March 2000 through November 2001
- Oversight Team Review - March 2001
- Field Season - January 2001 through November 2004
- Final Report - December 2005

Annual Reports due in March
Annual Presentations due in November
Annual Study Plans presented to SRWG in September

c. Juvenile salmon passage through the hydrosystem may cause a decline in fish condition through stress that may not cause immediate mortality, but may be manifested once the added stress of saltwater entry is encountered in the estuary and near-shore ocean environment. This "delayed mortality" of outmigrating smolts in the near-shore ocean is not understood and research has been limited due to the problematic nature of conducting research in the ocean with small fish which are released hundreds of kilometers upstream. With recent advancements in technology however, this problem may now be evaluated.

The feasibility of conducting a study to obtain the information on the differential and delayed mortality of juvenile salmon by incrementally partitioning and comparing mortality rates between the salt and fresh water interface in the estuary through the Columbia River plume in the near-ocean environment. Tracking of juvenile salmon through the salt/fresh water interface and Columbia River plume, coupled with information from the ongoing study to radio track salmon through the estuary to the salt water interface, will provide mortality rates from fish with known passage histories and help to identify where mortality occurs. This information will be used to focus on potential improvements that could be made to the management of the hydrosystem and transportation program.

- Feasibility - March 2000 through November 2001
- Field Season - January 2000 through November 2004
- Final Report - December 2005

Annual Reports due in March
Annual Presentations due in November
Annual Study Plans presented to SRWG in September

d. Comparison of physiological differences (energy levels, health, smoltification, and growth) in the condition of fish that have passed through the various routes of hydrosystem passage will help to isolate the operational procedures that compromise the fishes ability or aggravates a condition that reduces the chance for survival in the estuary and ocean. This work shall be coordinated with evaluations of multiple bypass evaluations and the transportation studies.

- Physiology differences in know source Snake River fish utilizing different passage routes.
- Evaluation of energy consumption in salmon with different migration histories.
- Stress induced changes in enzymes that regulated osmoregulation.

e. Investigate the feasibility of conducting a delayed mortality evaluation downstream of Bonneville. Number of fish required for rearing studies are relatively small when compared to the sample sizes necessary for the adult-return studies. It may be possible to modify the PIT tag detectors located on the PIT tag trawler to divert specific groups of PIT tag fish in sufficient numbers to conduct a rearing study in the estuary. The information provided from this type of study would supplement the proposed upstream rearing study by providing the additional system effects that may attribute to the environment downstream of Bonneville (environmental condition, predator avoidance, stress, energy depletion, disease transmission).

- Investigate Feasibility – November 2001

Milestone	Date (Mo/Yr)

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
1,400,000				

4. Issues – Rearing work and physiological evaluations requires research fish from known sources to be available. This will require marking at upstream hatcheries or increasing marking of wild fish in the tributaries. Based on previous mark and recovery efforts, fish of known sources from the Snake River that are recovered at Bonneville will require an increase in current marking efforts of about 30%.

Construction work at Bonneville may cut short the delayed rearing study, depending on the pending decision on Bonneville's configuration. If the sluiceway becomes the main route of passage few research fish will be available for this evaluation. Therefore, the rearing study should be expedited to get as much information as possible in this event. In this circumstance, if the rearing study is not complete, special operations may be requested to ensure that sufficient research fish are diverted for evaluation.

5. RPA Action

- **Directly Supports Reasonable and Prudent Alternative:**

Action 47: "During all transport evaluations, the Corps and BPA, in coordination with NMFS through the annual planning process, shall include an evaluation of delayed mortality (D) of transported versus inriver migrating juvenile anadromous salmonids."

- **Indirectly Supports Reasonable and Prudent Alternative:**

Action 189: "The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies to investigate the causes of discrepancies in adult return rates for juvenile salmonids that have different passage histories through the hydrosystem."

Action 186: The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for comparative evaluations of the behavior and survival of transported and downstream migrants to determine whether causes of D can be identified for the reach between Bonneville Dam and the mouth of the Columbia River.

Action 185: "The Action Agencies shall continue to fund and expand, as appropriate, fish marking and recapturing programs aimed at defining juvenile migrant survival for both transported and nontransported migrants and adult returns for both groups. These studies shall also compare the SARs of transported and nontransported fish to calculate the differential delayed mortality (D), if any, of transported fish."

Action 199: "The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H."

13. Lower Granite Surface Bypass and Collection

Multi-Year Plan

1. Project Information

- **Purpose/Objective**: Lower Granite Surface Bypass and Collection (SBC) has become a regional prototype test facility in which SBC concepts can be tested, with76 potential application at other Federal and non-Federal projects. The primary objectives for developing the SBC technology was to; increase the number of juvenile fish guided for bypass or collection through non-turbine routes, reducing fish stress, injury, migration delays; and reduce high-spill levels that are associated with dissolved gas problems and lost power generation. The SBC testing has consisted of several years of prototype testing of juvenile fish bypass efficiencies (attraction to fish bypass entrances), and occlusion (system to discourage fish attraction or horizontal redistribution in the forebay). The initial test, the prototype SBC was constructed in 1996. In 1998, the Behavioral Guidance Structure (BGS) and the Simulated Wells Intake (SWI) were constructed. The Removable Spillway Weir (RSW) is being constructed for initial tests in 2001 and 2002. The SBC, BGS and the SWI tests were prototypes, designed as temporary structures with limited test protocols. The tests to date have been extremely useful to determine actual biological performances under various flows, entrance configurations and project operations. The RSW concept is based on results of the SBC testing at Lower Granite and elsewhere. The existing spillways rely on 50-foot deep gates that subject the juvenile fish to rapid pressure changes and high velocities. The SBC testing has determined that surface flow provides the best attraction and highest effectiveness to pass juvenile fish. The RSW will pass approximately 11-foot deep surface flow over a shaped weir, and will be the first test of surface flow (6000-11000cfs) over a weir installed at a spillway. The Lower Granite RSW is designed to be removable to return the spillway to design capacity if needed to pass a major flood event. If the RSW performs as intended, the structure will become an “operating” prototype with extended application for fish passage. Continued testing at Lower Granite also provides data to determine detailed juvenile fish behavior. The data allows fine-scale research of juvenile fish responses under varying hydraulic and environmental conditions. The information continues to be examined using computational fluid dynamic modeling, detailed biological field tracking techniques, then correlated in models to yield explanations of fish behavior at the hydropower projects. This effort, while preliminary, may lead to a more complete understanding of fish behavior with extended application to design more efficient fish passage systems at hydropower projects.

  The testing will have broad application to other hydropower projects. The Biological Opinion emphasizes continued development of the bypass technologies (RSW’s and occlusion systems) at other Snake and Columbia River sites based on presumed successful tests at Lower Granite. RSW and occlusion systems are anticipated to provide increased project survival and reduced biological risks by providing safer passage routes with less delay, reduce gas supersaturation and reduced turbine intake entrainment.

- **Description -** In 1996 a prototype partial powerhouse SBC was constructed to test concepts of collection and bypass at powerhouse units 4,5 and 6. The partial powerhouse test was

developed to minimize costs (vs. a full powerhouse prototype) and make performance estimates for a full powerhouse system. The prototype has been tested under various entrance configurations and flow conditions since the initial test in the spring of 1996. The primary test objective was to evaluate the effectiveness of vertical slots in attracting juvenile salmonids. The test was characterized as a "proof of concept" test.

The 1997 test was a validation test of the 1996 configurations, with one significant change. The middle vertical slot was modified to provide an overflow weir effect versus an orifice effect previously tested. This modification was based on results of testing completed at Ice Harbor in 1995 that indicated juveniles had a preference for an overflow weir versus an orifice. The 1997 test results verified the hypothesis.

The 1998 test evaluated the effectiveness of the vertical slots tested in 1996/97 in combination with two major modifications to the structure: 1) the installation of simulated Wells intake (SWI) and; 2) installation of the BGS. Results of this test were; fish passage through the Lower Granite SBC relative to units 4 – 6 went from 37% in 1997 to 51% in 1998, presumably because of the addition of the SWI. For the best entrance configuration, the percentage was even higher (53.6%). When the SBC was combined with the existing screen system, 89.5% of the fish passing the entire powerhouse did so by routes other than the turbines. The BGS, an 1,100 foot long steel "wall" angled upstream from the south end of the SBC, diverted 78% of the fish destined for the south half of the powerhouse.

In 1999 the National Marine Fisheries Service and the state fishery agencies requested that the SBC/BGS be placed in an operating mode, recognizing the passage benefits gained by the prototype structure. A minimal hydro-acoustic monitoring program was deployed in that year.

In FY 2000 the SBC scope and objectives were as follows;

a. Modify one SBC entrance to compare behavioral response to between the abrupt middle entrance and newly modified BGS entrance, to determine if collection performance of the entrances can be increased. Evaluate the performance of the SBC entrances utilizing significantly higher flows (3500 cfs vs. 2000 cfs at the middle entrance) and shallower entrances (approx. 20 feet weir depth) compared to past operations.
b. Evaluate the performance of the BGS under design flows higher than was tested in 1998 and 1999. In those years only two turbines were operational due to plant equipment problems. In 2000 three turbine units were available for service on the south side of the BGS.
c. Continue field and modeling research to determine, to the extent possible, how juvenile fish respond to various environmental conditions including hydraulic, acoustic, magnetic, illumination, and day versus night responses. This effort is a collaboration between Iowa Institute of Hydraulic Research (numeric CFD modeling), Battelle (field fish behavior monitoring, tracking, and research) and Waterways Experiment Station (fish behavior research, data mining, and computational fish behavior analysis) as coordinated by NWW
d. Evaluate the performance of turbulent flow attraction tests to determine if SBC performance can be enhanced. Tests were conducted at Cowlitz Falls in 1999 (turbulent attraction and strobe light avoidance) and 2000 (turbulent attraction). Future applications being considered include:
    - Evaluate turbulent flow to guide or attract juvenile fish into SBC entrances. Intent is to guide fish to a desirable location.
    - Evaluate turbulent flows to guide fish past (occlude) the upstream gap in the BGS. Intent is to guide juveniles away from undesirable location.

- Evaluate avoidance response to strobe lights to test if fish can be guided away from undesirable passage routes such as turbine intakes.
- Evaluate attraction lighting to attract juvenile fish to near desirable passage route entrances.

FY 2001 objectives:

a. Remove SBC connection at spillway #1 to south non-overflow section for subsequent installation of the RSW.
b. Construct Removable Spillway Weir (RSW). The RSW will allow full-flow surface bypass (approx. 6000-11,000 cfs) tests at spillway #1 versus existing 50-foot deep gated spill. A prototype is being fabricated and is planned for testing in 2001/2002. The prototype will be designed to be removable to maintain emergency flood capacity of the spillways by rotating upstream and lowered by controlled "removal" of the structure. The structure can be retrieved after removal by raising with air delivery systems.
c. Biological Studies (AFEP) – There will be two primary means of measuring performance, depending on the test objectives: hydroacoustics, which samples thousands of fish passing the dam, but cannot distinguish between species; and radiotelemetry, which provides species specific information on fish movement and passage. Other possible evaluation methods include 3-dimensional sonic tracking, multibeam hydroacoustics and mobile split-beam hydroacoustics for measuring fish behavior in the forebay and in the vicinity of the test structures.

2. Major Activities/Tasks –

Milestone	**Date (Mo/Yr**
FY 2002	
Conduct initial hydraulic/biological tests of the RSW in the fall of 2001. Install flow vanes on the RSW if the tests determine necessary.	10/01 to 2/02
Conduct spring biological test of the RSW. Complete any operational tests of the RSW as needed. Install BGS for spring out-migration.	3/02 to 6/02
Contract preparation for RSW completion and operation issues, if needed.	4/02 to 9/02
Investigate feasibility of realignment of the BGS between unit 6 and the spillway. If determined feasible, initiate P&S for the realignment for 2004.	10/01-9/02
Conduct summer FGE test related to the SBC structure in front of units 4-6, as warranted. (SBC off) Past test data indicates FGE increase fall chinook.	7/02
FY 2003	
RSW spring test verification. Install BGS for spring outmigration only. M&E to be determined (TBD).	3/03 to 6/03
Test turbulent flow concepts as warranted (along SBC face to RSW).	3/03 to 6/03
Last opportunity for summer FGE test of SBC at 4-6 if not	7/03

conducted in prior years. BGS out.	
Complete P&S (if determined feasible) for realigned BGS between unit 6 and spillway.	10-02 to 9/03
Initiate PED for RSW at LSR/MNA.	10-02 to 9-03
Prepare P&S to remove remaining components of SBC/SWI in FY 04.	10-02 to 9-03
FY 2004	
Remove prototype SBC/SWI winter of 03-04.	12/03 to 3/04
Realign BGS to unit 6, if determined feasible.	12/03 to 3/04
Initiate E&D for permanent BGS system. BGS system to allow flexibility to transport in summer/spring as required due to river conditions.	10/03 to 9/04
Detailed P&S for RSW at LSR/MNA (location(s) TBD as warranted). Costs to be included in site specific multi-year plans.	10-03 to 9-04
Test turbulent flow concepts as warranted (along SBC face to RSW).	3-04 to 5/04
Operate RSW with full powerhouse occlusion (BGS). Monitoring TBD.	3-04 to 6/04
FY 2005	
Prepare P&S to remove prototype BGS.	10/04 to 9/05
Complete P&S for permanent BGS system. BGS system to allow flexibility to transport in summer/spring as required due to river conditions.	10/04 to 9/05
Operate RSW with full powerhouse occlusion (BGS). Monitoring TBD.	3/05 to 6/05
FY 2006	
Initiate contract - permanent BGS system.	10/05 to 9/06
Operate RSW. Monitoring TBD.	3/06 to 6/06
Remove prototype BGS.	6/06 to 9/06
FY 2007	
Complete construction of permanent BGS system.	10/06 to 4/07
Operate RSW and BGS. Monitoring TBD.	3/07 to 6/07
FY 2008	
Prepare and issue completion contracts, final operational adjustments.	6/07 to 9/07
Operate RSW and BGS. Monitoring TBD.	3/08 to 6/08
Beyond FY 2008	
Operate permanent RSW/BGS systems.	Per FFP

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
5956K	**4851K**	**7969K**	**3614K**	**4156K**

4. Issues Priorities for continued development at LSR and LCR may be based on RSW and powerhouse occlusion testing at Lower Granite.

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5. **RPA Action –** RSW's are anticipated to provide increased effectiveness for in-river passage, reduced turbine passage, reduced TDG, reduced forebay residence time and increased project survival. In addition, adults may benefit by reduced turbine mortality and increased kelt passage rates at projects that deploy occlusion systems and/or surface passage routes.

RPA reference	**RPA summarized text**
Action 75:	The Corps shall investigate a surface bypass RSW at McNary Dam, based on prototype results at other locations, and shall install the unit in multiple spillway bays, as warranted.
Action 77:	The Corps shall investigate surface bypass (e.g., RSW) at Lower Monumental Dam, based on prototype results at other locations, and install in multiple spillway bays, as warranted.
Action 80:	The Corps shall continue the design development, fabrication/deployment, and testing of a prototype RSW at Lower Granite, in conjunction with the existing prototype powerhouse occlusion devices, including the forebay behavioral guidance structure (BGS) and upper turbine intake occlusion devices. As warranted by prototype test results, the Corps shall install one or more permanent RSWs and occlusion devices at appropriate lower Snake hydro projects, in coordination with the annual planning process.
Action 83:	The Action Agencies, in coordination with NMFS through the annual planning process, shall evaluate the effect of spill duration and volume on spillway effectiveness (percent of total project passage via spill), spill efficiency (fish per unit flow), forebay residence time, and total project and system survival of juvenile steelhead and salmon passing FCRPS dams. Studies shall include both collector and non-collector projects. Adult passage considerations and potential adult fallback shall also be considered in study designs. Little Goose and Lower Granite dams shall be specifically considered for daytime spill studies. An overall phased study approach for spill evaluations will be determined in the 1- and 5-year implementation plans.
Action 85:	The Corps shall continue to develop and evaluate improved fish-tracking technologies and computational fluid dynamics (numerical modeling). The ability to integrate these technologies and fluid dynamics shall be assessed as a potentially improved means of determining fish responses to forebay hydraulic conditions.
Action 86:	The Corps shall continue to investigate a way to increase entry rates of fish approaching surface bypass/collector entrances.
Action 99:	By January, 2003, the Action Agencies shall develop an analysis that compares the relative passage survival benefits of replacing existing standard-length intake screens with extended-length screens at the Lower Monumental Dam powerhouse turbines to a removable RSW surface bypass system.
Action 109:	The Corps shall initiate an adult steelhead downstream migrant (kelt) assessment program to determine the magnitude of passage, the contribution to population diversity and growth, and potential actions to provide safe passage.
Action 111:	The Corps shall investigate and enumerate fallback of upstream migrant salmonids through turbine intakes at all lower Snake and lower Columbia River dams. The Corps shall implement corrective measures to reduce turbine mortality, as warranted.
Action 134:	The Corps shall continue the spillway deflector optimization program at each FCRPS project and implement it, as warranted. The Corps and BPA shall conduct physical and biological evaluations to ensure optimum gas abatement and fish passage

RPA reference	RPA summarized text
	conditions. Implementation decisions will be based on the effect of spill duration and volume on TDG, spillway effectiveness, spill efficiency, forebay residence time, and total project and system survival of juvenile salmon and steelhead passing FCRPS dams.
Action 138:	The Corps shall continue to investigate RSWs, in conjunction with extended spillway deflectors, as a means of optimizing safe spillway passage of adult steelhead kelts and juvenile migrants.

14. Little Goose Extended Submerged Bar Screens

Multi-Year Plan

1. Project Information

- **Purpose/Objective**: Extended submerged bar screens (ESBS's) were installed at Little Goose in the spring of 1996. Many of the operational problems initially encountered, such as the brush control systems have been corrected. After the initial ESBS installations, perforated plate connections failed and caused extensive damage to the ESBS. It was determined that the bolted connections were not adequate, and the porosity plate "orifices" causes vibrations that may contribute to the bolted connection failure. After the cause of the problem was identified, field vibration tests were conducted in FY98 and physical modeling efforts were conducted in FY99 at Iowa Institute of Hydraulic Research. Several alternative plate orifice configurations were tested, with promising results. In addition, the perforated plates and the connections were redesigned. In FY99 and FY00, Fish Guidance Efficiency (FGE) and mechanical tests were conducted at Little Goose dam and confirmed the vibrations and accelerations could be substantially reduced. The tests also confirmed the new plate design did not adversely affect FGE performance.

- **Description –** In FY01, all sets of perforated plates (18 + 1 prototype) at Little Goose are under contract and are being replaced. The ESBS system-wide report will also be completed to identify complete inventory of the problems encountered, and to identify any other improvements necessary to ensure reliable operation of the ESBS.

  In FY 02 improvements identified in the ESBS system-wide report will be initiated. Some of the identified improvements are; replace the bladder valve stems with stainless steel; replace bar screen in upper right corner or install porosity panels behind the bar screens; improve cable handling and wear issues, and investigate more reliable seals for the gear boxes.

  A related effort is vertical barrier screen (VBS) modeling effort at Waterways Experiment Station (WES) in FY01. Potential actions may result depending on determinations and findings.

2. Major Activities/Tasks –

Milestone	Date (Mo/Yr
FY 2002	
Prepare contracts for ESBS improvements	10/01 – 2/02
Finalize and close out perforated plate replacement contract.	9 / 02
FY 2003	
Finalize any outstanding contracts/actions. Finalize as-constructed drawings/specs/files.	9 /03

3. **Cost Estimate**

FY02	FY03	FY04	FY05	FY06
229K	**105K**	**0**	**0**	**0**

4. **Issues:** Assumptions for contract close-out need to be revised based on actual costs/final negotiations with contractors.

5. **RPA Action –**

RPA reference	**RPA summarized text, D=direct relationship, I = indirect relationship**	
Action 52:	The Corps shall identify and implement improvements to the transportation program.	I
Action 74:	The Corps shall continue evaluations to assess the need for improvements of the existing intake screens, gatewell vertical barrier screen cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at McNary to determine where improvements are necessary to reduce problems experienced during the 1996 flood, increase fish survival, and resolve holding and loading facility problems, including raceway jumping by juvenile salmon and steelhead and debris plugging of bypass lines. Additionally, the Corps shall evaluate whether the existing juvenile bypass system outfall should be relocated.	I
Action 94:	The Corps shall continue to evaluate the need for improvements of the existing intake screens, gatewell vertical barrier screens' cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at the four lower Snake River hydropower projects.	D
Action 96:	The Corps shall complete the extended submerged intake screen system-wide letter report and implement recommended improvements.	D

15. Lower Granite Extended Submerged Bar Screens

Multi-Year Plan

1. Project Information

- **Purpose/Objective**: Extended submerged bar screens (ESBS's) were installed at Lower Granite in the spring of 1996. Many of the operational problems initially encountered, such as the brush control systems have been corrected. After the initial ESBS installations, perforated plate connections failed and caused extensive damage to the ESBS. It was determined that the bolted connections were not adequate, and the porosity plate "orifices" causes vibrations that may contribute to the bolted connection failure. After the cause of the problem was identified, field vibration tests were conducted in FY98 and physical modeling efforts were conducted in FY99 at Iowa Institute of Hydraulic Research. Several alternative plate orifice configurations were tested, with promising results. In addition, the perforated plates and the connections were redesigned. In FY99 and FY00, Fish Guidance Efficiency (FGE) and mechanical tests were conducted at Little Goose dam and confirmed the vibrations and accelerations could be substantially reduced. The tests also confirmed the new plate design did not adversely affect FGE performance.

- **Description –** In FY01, all sets of perforated plates (18 + 1 prototype) at Lower Granite are under contract and are being replaced. The ESBS system-wide report will also be completed to identify complete inventory of the problems encountered, and to identify any other improvements necessary to ensure reliable operation of the ESBS.

  In FY 02 improvements identified in the ESBS system-wide report will be initiated. Some of the identified improvements are; replace the bladder valve stems with stainless steel; replace bar screen in upper right corner or install porosity panels behind the bar screens; improve cable handling and wear issues, and investigate more reliable seals for the gear boxes.

  A related effort is vertical barrier screen (VBS) modeling effort at Waterways Experiment Station (WES) in FY01. Potential actions may result depending on determinations and findings.

2. Major Activities/Tasks –

Milestone	Date (Mo/Yr
FY 2002	
Prepare contracts for ESBS improvements	10/01 – 2/02
Finalize and close out perforated plate replacement contract.	9 / 02
FY 2003	
Finalize any outstanding contracts/actions. Finalize as-constructed drawings/specs/files.	9 /03

3. **Cost Estimate**

FY02	FY03	FY04	FY05	FY06
229K	**105K**	**0**	**0**	**0**

4. **Issues:** Assumptions for contract close-out need to be revised based on actual costs/final negotiations with contractors.

5. **RPA Action –**

RPA reference	**RPA summarized text, D=direct relationship, I = indirect relationship**	
Action 52:	The Corps shall identify and implement improvements to the transportation program.	I
Action 74:	The Corps shall continue evaluations to assess the need for improvements of the existing intake screens, gatewell vertical barrier screen cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at McNary to determine where improvements are necessary to reduce problems experienced during the 1996 flood, increase fish survival, and resolve holding and loading facility problems, including raceway jumping by juvenile salmon and steelhead and debris plugging of bypass lines. Additionally, the Corps shall evaluate whether the existing juvenile bypass system outfall should be relocated.	I
Action 94:	The Corps shall continue to evaluate the need for improvements of the existing intake screens, gatewell vertical barrier screens' cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at the four lower Snake River hydropower projects.	D
Action 96:	The Corps shall complete the extended submerged intake screen system-wide letter report and implement recommended improvements.	D

16. Lower Monumental Extended Submerged Bar Screens

Multi-Year Plan

1. Project Information

- **Purpose/Objective**: Extended submerged bar screens (ESBS's) have been installed at McNary, Lower Granite and Little Goose projects. Lower Monumental currently has standard length screens. Improved fish guidance efficiency would enhance survival by diverting a higher percentage to bypass and collection facilities, and reduce direct/indirect turbine moralities.

- **Description –** In FY01, a study plan will be prepared to identify the appropriate actions and schedule to implement extended screens at Lower Monumental Lock and Dam. There are six turbine units, similar to the other Snake river projects, with three slots per turbine intake, requiring a total of (18) turbine intake screens plus (1) spare anticipated. With additional fish collection capacity, the fish facility design should be reviewed to ensure maximum protection for the increased numbers of juvenile fish being routed.

  In FY 02, the coordinated plan will be initiated. It is expected that models will be prepared at Waterways Experiment Station, research of existing site conditions and constraints will be identified, and preliminary design will be initiated.

  Related documentation: McNary Juvenile Fish Guiding Efficieny Justification Report, April 1991; McNary Turbine Intake Screening System, FDM No. 33, March 1994; FDM No. 33, Supplement No. 1, McNary Turbine Intake Screening System, November 1997; Lower Granite Juvenile Fish Guiding Efficiency Justification Study, Feasibility Report; December 1986, Little Goose Juvenile Fish Guiding Efficiency Justification Study, Feasibility Report, July 1987; Lower Granite and Little Goose Locks and Dams, Turbine Intake Screening System, FDM No.s 42 and 30, December 1994.

2. Major Activities/Tasks –

Milestone	Date (Mo/Yr
FY 2002	
Prepare/modify models – run initial tests (WES)	11/01 – 9/02
IIHR modeling	11/01 – 6/02
Research past reports, facility review, and site verifications	11/01 – 9/02
Prepare preliminary design report and DDR	4/02 – 12/02
FY 2003	
Prepare P&S for prototype screens, initiate contracts	1/03 – 6/04
Prepare biological testing plans	6/04 – 9/04
FY 2004	
Construct/install prototype ESBS and VBS	8/04 – 2/05

Milestone	Date (Mo/Yr
Biological testing (AFEP)	4/05 – 5/05
FY 2005	
Biological data reports and screen selection reports	7/04 – 9/05
Prepare P&S for final screens, if warranted	6/04 – 9/05
FY 2006	
Prepare final DDR	10/05 – 6/06
Initiate contracts for remaining ESBS and VBS	12/05 – 9/06
FY 2007	
Final installations ESBS-VBS	10/06 – 4/07
Post construction evaluations (AFEP) (two seasons, 06 partial, 07 all screens)	5/06 and 5/07
Final screen selection reports	6/07 – 9/07

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
575K	**525K**	**1918K**	**505K**	**4000K**

4. Issues: RPA 99 may reduce or eliminate actions after 2003, depending on decisions on RSW's and developments. Depending on river conditions and use priorities, the fisheries agencies may determine both extended screens and RSW's may be necessary at Lower Monumental. The scenarios are; low flow years (maximize transport spring and summer); typical flow years to maximize in-river passage (spring) and transport (summer); and unusually high flow years, where in-rive passage may predominate.

5. RPA Action –

RPA reference	**RPA summarized text, D=direct relationship, I = indirect relationship**	
Action 52:	The Corps shall identify and implement improvements to the transportation program.	I
Action 74:	The Corps shall continue evaluations to assess the need for improvements of the existing intake screens, gatewell vertical barrier screen cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at McNary to determine where improvements are necessary to reduce problems experienced during the 1996 flood, increase fish survival, and resolve holding and loading facility problems, including raceway jumping by juvenile salmon and steelhead and debris plugging of bypass lines. Additionally, the Corps shall evaluate whether the existing juvenile bypass system outfall should be relocated.	I

RPA reference	RPA summarized text, D=direct relationship, I = indirect relationship	
Action 78:	**The Corps shall initiate design development and testing of extended submerged intake screens and vertical barrier screens at Lower Monumental Dam and construct units as warranted.**	D
Action 94:	The Corps shall continue to evaluate the need for improvements of the existing intake screens, gatewell vertical barrier screens' cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at the four lower Snake River hydropower projects.	I
Action 96:	The Corps shall complete the extended submerged intake screen system-wide letter report and implement recommended improvements.	I
Action 99:	**By January, 2003, the Action Agencies shall develop an analysis that compares the relative passage survival benefits of replacing existing standard-length intake screens with extended-length screens at the Lower Monumental Dam powerhouse turbines to a removable RSW surface bypass system.**	D

17. McNary Extended Submerged Bar Screens

Multi-Year Plan

1. Project Information

- **Purpose/Objective**: Extended submerged bar screens (ESBS's) were installed at McNary in the spring of 1996 and 1997. Many of the operational problems initially encountered, such as the brush control systems have been resolved. After the initial ESBS installations, perforated plate connections failed and caused extensive damage to the ESBS. One screen severely damaged and was placed in the maintenance yard for future repair/replacement. It was determined that the bolted connections were not adequate, and the porosity plate "orifices" causes vibrations that may contribute to the bolted connection failure. After the cause of the problem was identified, field vibration tests were conducted in FY98 and physical modeling efforts were conducted in FY99 at Iowa Institute of Hydraulic Research. Several alternative plate orifice configurations were tested, with promising results. In addition, the perforated plates and the connections were redesigned. In FY99 and FY00, Fish Guidance Efficiency (FGE) and mechanical tests were conducted at Little Goose dam and confirmed the vibrations and accelerations could be substantially reduced. The tests also confirmed the new plate design did not adversely affect FGE performance.

- **Description –** In FY01, all sets of perforated plates (41 new + 3 prototype screens) at McNary are under contract and are being replaced. P&S will be prepared to replace the (1) spare ESBS that was damaged in 1997. The ESBS system-wide report will also be completed to identify complete inventory of the problems encountered, and to identify any other improvements necessary to ensure reliable operation of the ESBS.

  In FY 02 improvements identified in the ESBS system-wide report will be initiated. Some of the identified improvements are; replace the bladder valve stems with stainless steel; replace bar screen in upper right corner or install porosity panels behind the bar screens; improve cable handling and wear issues, and investigate more reliable seals for the gear boxes. The contract for the replacement screen will be advertised and construction initiated.

2. Major Activities/Tasks –

Milestone	Date (Mo/Yr
FY 2002	
Prepare contracts for ESBS improvements	10/01 – 2/02
Issue contract for (1) ESBS replacement screen (damaged in 1997 prior due to perforated plate failure)	11 / 01
Finalize and close out perforated plate replacement contract.	9 / 02
FY 2003	
Finalize any outstanding contracts/actions. Finalize as-constructed drawings/specs/files.	9 /03

3. **Cost Estimate**

FY02	FY03	FY04	FY05	FY06
808K	**170K**	**0**	**0**	**0**

4. **Issues:** Assumptions for contract close-out need to be revised based on actual costs/final negotiations with contractors.

5. **RPA Action –**

RPA reference	**RPA summarized text, D=direct relationship, I = indirect relationship**	
Action 52:	The Corps shall identify and implement improvements to the transportation program.	I
Action 74:	The Corps shall continue evaluations to assess the need for improvements of the existing intake screens, gatewell vertical barrier screen cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at McNary to determine where improvements are necessary to reduce problems experienced during the 1996 flood, increase fish survival, and resolve holding and loading facility problems, including raceway jumping by juvenile salmon and steelhead and debris plugging of bypass lines. Additionally, the Corps shall evaluate whether the existing juvenile bypass system outfall should be relocated.	D
Action 94:	The Corps shall continue to evaluate the need for improvements of the existing intake screens, gatewell vertical barrier screens' cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at the four lower Snake River hydropower projects.	I
Action 96:	The Corps shall complete the extended submerged intake screen systemwide letter report and implement recommended improvements.	D

18. Lower Snake River Juvenile Bypass System Improvements

Multi-Year Plan

1. Project Information

- **Purpose/Objective.** The existing juvenile fish bypass systems (JBS's) at each of the four Lower Snake River projects will be evaluated and modified to make these systems more reliable and fish friendly.

- **Description.** An engineering and biological assessment of the operational performance of each of the four lower Snake River project's JBS's will be completed. A report will be prepared documenting the assessment and any recommendations concerning modifications which may improve performance. The assessments will consider new information from ongoing and completed research and development (R&D) projects such as the Evaluation Separator, McNary Cylindrical Dewatering Prototype Evaluations and the Lower Granite surface collection and removable spillway weir projects, however, implementation of some of these elements into an existing facility will likely require extensive modifications. This effort is focused more on minor or less extensive modifications which can be done quickly and provide some performance improvements. Some problems may be identified during this review process that require further R&D before solutions can be implemented. This R&D will be independent of this effort until the results can re-contribute to this program.

2. Major Activities/Tasks. The following milestones are anticipated.

Milestone	Date (Mo/Yr)
Complete Evaluation Report	September/02
Complete Contract documents	September/03
Construction complete	September/04

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$150k	$225k	$450k		

4. Issues. The schedules and costs may change from that shown depending on the recommendations resulting from the assessment.

5. RPA Action.

- Action 53 - The Corps shall evaluate and implement structural and operational alternatives to improve juvenile transportation at the collector dams.
- Action 94 - The Corps shall continue to evaluate the need for improvements of the existing intake screens, gatewell vertical barrier screens' cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at the four lower Snake River hydropower projects.

19. Multiple Bypass Accumulative Impacts

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - One of the major tools for fish passage management incorporates the use of the juvenile bypass systems at the dams. Adult return data from the marked juvenile chinook releases at Lower Granite and the upstream tributary releases of marked hatchery fish indicated there that there may lower long-term survival of fish that pass through the multiple juvenile fish bypass systems on the Snake and Columbia Rivers compared to fish that were transported around the dams or bypassed the dams via spill. Although the data set is small and is not statistically significant, the potential for lower survival is a real concern because the trend of lower adult returns from this passage group appears across several years of data. In addition, this trend is supported by preliminary data on physiological changes and energy consumption of multiple bypassed fish compared to spill bypass fish. Because the data sets are not clear there are regional disagreements on the future designs, uses of these systems and management of the hydrosystem for the improved survival of salmon. The focus of this project is to confirm multiple passage effects, identify the causes and find solutions to alleviate and reduce the effects of multiple bypass system on survival.

  Currently, there are three areas of focus as to why the multiple bypass systems may cause lower survival.
  Accumulative impacts to the physiology of the fish - Passage through the juvenile fish bypass facilities may create a physiological change in the fish that is accumulative through each sequential bypass process (such as chronic elevated stress, losses of energy stores, and phase of smoltification). The accumulative physiological response reduces the likelihood a fish will grow, resist diseases, complete smoltification and successful transition to the saltwater environment, while at the same time avoiding predators.

  Site specific mortality - A potential source of multiple bypass loss may be one or more unique conditions at the bypass facilities that result in direct or indirect losses. The site-specific reduction in survival may dilute the survival benefits offered by the other bypass systems. Multiple bypass effects are not observed in data sets from fish bypassed at Lower Granite or Little Goose. The return rates for these juveniles' salmon are similar to the group of fish passed through the hydro-system via spill. Multiple bypass effects are not detected in the data until fish have been bypassed at Lower Monumental. Furthermore, results of project survival studies (spill, bypass, and turbine passage) conducted at Lower Monumental indicate a lower rate of downstream survival compared to survival through the various routes of passage at the upstream hydro-projects. Although Lower Monumental appears to be problematic based on this data, these data sets may be misleading. Survival downstream of Lower Monumental has not been partition to assign mortality to passage through Ice Harbor, the reservoirs, nor the confluence of the Snake and Columbia Rivers.

  A stock's propensity for diversion through a bypass system - The third concept is based on the idea that a condition exists inherent to the fish (genetics, hatchery origin, disease, or stage of smoltification) that is independent of the hydro-system and yet, this natural difference leads to a greater chance for these fish or stocks to be diverted through the bypass facilities.

- **Description** - This project investigates the factors that cause additional mortality or the lower survival due to accumulative stress, injury and predation of fish that pass through multiple juvenile bypass systems. Once specific causes are identified, solutions will be evaluated at the problem

areas on the Snake and Columbia Rivers. This work is closely associated with the effort to improve juvenile fish facilities on the Snake and MaNcary dams.

2. Major Activities/Tasks -

a. Confirmation of Multiple Bypass Impacts on Survival: Investigate ways to enhance the adult return data sets by supplementing the release groups of on-going studies. The currently the data sets are ineffectual because of their high annual variability and because they are plagued with too many uncontrolled intrusions to provide clear guidance on the role of bypass systems in fish passage management. Negotiations on supplementing additional PIT tag marking of specific stocks of fish have been initiated with the Pacific States Marine Fish Commission for Snake River chinook stocks. NMFS is seeks a means for increasing marked groups of wild fish.

b. Conduct an Independent Data Review: Much of the salmon survival and passage data analysis and review is conducted by NMFS not only in their role in ESA but also as the researches funded by the Corps to obtain the data for these databases. An independent review of the PIT tags data sets to answer specific questions related multiple bypass, survival and adult returns and will ensure independence and quality control between data analysis and data acquisition. This need has become more urgent because of the importance of performance measures (which will be determined by analysis of the PIT tag data) in the 2000 Biological Opinion. Review of historical data and the contemporary PIT tag data to assess the adult return rates of juvenile salmon that were multiply bypassed will be initiated in FY01 pending the availability of funds.

c. Partition Mortality Between Lower Monumental and McNary Dams. Focus on site specific mortality that may contribute to increased mortality to fish that pass through the bypass systems. (Currently this effort is part of the Ice Harbor Spill evaluation.)

d. Identify Site Specific Mortality: Incrementally partition survival through different components of the juvenile bypass facilities at Lower Monumental, Ice Harbor Dam and McNary (upstream of the screens through the facilities to predation at the outfall). Try and isolate the cause of the previously documented lower survival from the Lower Monumental bypass facility survival data. This work is on hold until the outfall location at Lower Monumental Dam and McNary have been re-evaluated. Juvenile project survival studies are planned for several years at Ice Harbor following the completion of the prototype separator development. (Currently McNary is being re-evaluated with respect to fall chinook under the juvenile fish facility effort.)

e. Identify Differences in Physiological and Energy Consumption in Multiple Bypassed Fish: Compare physiological differences (energy levels, smoltification and growth) in the condition of fish that have been multiply bypassed (multiple - passive integrated transponder tag detection) to salmon that passed in-river (one – passive integrated transponder tag detection). This work involves the sub-sampling of the in-river group of salmon from the ongoing comparative evaluation of the physiological changes of salmon that remain in-river versus salmon that are transported to the estuary by barge.

- Field Season - January 1999 through November 2003
- Final Report - December 2004

Annual Reports due in March
Annual Presentations due in November
Annual Study Plans presented to SRWG in September

f. Determine Differences in Survival Rate of Bypassed Fish: A study to evaluate differential survival rates of fish with known passage histories (multiple bypass and in-river passage). This work is a multiple year study in which fish of different passage histories will be collected at Bonneville Dam. Then held up to eight months in a saltwater rearing facility to determine the rate of mortality and to identify causes of mortality.

- Feasibility - March 2000 through November 2001
- Oversight Team Review - February 2001

- Field Season - January 2001 through November 2005
- Final Report - March 2006

Annual Reports due in March
Annual Presentations due in November
Annual Study Plans presented to SRWG in September

Milestone	Date (Mo/Yr)
Multiple Bypass Rearing Group of the Delayed Mort Eval. – Pilot study	Sept / 2001
Multiple Bypass Differential Mortality (Rearing) – start in FY 02	Mar / 2006
Comparative Physiology and Energy Budget – ongoing – Report	Mar / 2005
Data Review Report	Sep / 2002

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$500k	$550k	$550k	$350k	$350k

4. Issues – Identification of incremental mortality between Ice Harbor and McNary is being evaluated under the evaluation of Ice Harbor spill issues. Additional, delay and potential impacts cause by the McNary bypass system are being evaluated under the studies associated the improvement of the McNary juvenile fish facility.

5. RPA Action

- **Directly Supports Reasonable and Prudent Alternative:**
  Action 189 - The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies to investigate the causes of discrepancies in adult return rates for juvenile salmonids that have different passage histories through the hydrosystem.

- **Supports Elements Under Reasonable and Prudent Alternative:**
  Action 185 - The Action Agencies shall continue to fund and expand, as appropriate, fish marking and recapturing programs aimed at defining juvenile migrant survival for both transported and non-transported migrants and adult returns for both groups. These studies shall also compare the SARs of transported and non-transported fish to calculate the differential delayed mortality (D), if any, of transported fish.

  Action 94 - The Corps shall continue to evaluate the need for improvements of the existing intake screens, gatewell vertical barrier screens' cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at the four lower Snake River hydropower projects.

  Action 74 - The Corps shall continue evaluations to assess the need for improvements of the existing intake screens, gatewell vertical barrier screen cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at McNary to determine where improvements are necessary to reduce problems experienced during the 1996 flood, increase fish survival, and resolve holding and loading facility problems, including raceway jumping by juvenile salmon and steelhead and debris plugging of bypass lines. Additionally, the Corps shall evaluate whether the existing juvenile bypass system outfall should be relocated.

- Action 199 - The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H.

20. Separator Evaluation Project

Multi-Year Plan

1. Project Information

- **Purpose/Objective -** All currently operating juvenile fish separators share similar problems of low efficiency, high stress and delay. Inefficient separation of smolts by species results in high levels of stress experienced by juvenile chinook salmon when they are held with steelhead smolts during the transportation process. In addition, the delay of smolts within the separator and their exposure to confusing hydraulics environment expends critical energy reserves and adds to the level of stress experience by the smolts. Chronic stress compromises smolt physiology by impacting the endocrine, metabolic, osmoregulatory, and immune system functions and energy reserves of the fish. As a result, these physiological changes translates into reduced long term survival through by poor growth, increased susceptibility to disease, an inadequate or delayed transition into the saltwater environment, as well as impacting avoidance behavior to avian and picivourous predators.

  In the past, the lessons learned from existing separators have been incorporated into new designs on a trial and error basis. Each new design has improved on past separators. However, problems persist. Effective in-season management decisions made for the benefit of chinook salmon and steelhead depend on the ability of the existing juvenile fish facilities to separate these species in an efficient but low stress manner. The separator evaluation project is expected to lead to a separator design that achieves this goal. The best design will be implemented at the new Lower Granite juvenile fish bypass (JBS) facility when it is approved for implementation and will be considered for installation at other existing facilities such as Little Goose, Lower Monumental and McNary. Funding for this project is from the Columbia River Fish Mitigation Program.

- **Description -** A test separator system was constructed at Ice Harbor dam to allow prototype testing of design concepts to improve behavioral fish separation (small juvenile fish from larger juvenile fish). The first year of testing of the test separator at Ice Harbor occurred in FY99. Secondary separation concepts were evaluated with some success.

  A second year of testing in FY00 was performed to examine the performance standards (species and size separation efficiencies, passage rates and fish condition (descaling and stress) at the Ice Harbor test separator system. Evaluations also included an assessment of the efficiency of an adult separation component. During FY00, biological evaluations were conducted on improvements to existing style separators (lower velocities) in the McNary collection channel. Alterations in exit locations and shapes, tank volume and shape, and attraction flows alter the hydraulic environment and have the potential to improve the performance of the traditional style separators. The intent of this work is to provide an alternative high performance separator for use at pre-existing facilities that cannot incorporate a high velocity separator without a major facility modification.

  Fiscal Year 2001 is anticipated to be the final year for biological testing. In FY01, lighting effects will be tested at the Ice Harbor test facility. A prototype modification to the existing operational separator at McNary will be tested. The test facility at Ice Harbor was constructed to be a temporary facility and hence certain items such as painting were not completed on some of the components. Rather than remove the facility, fishery agencies desire to keep it intact for future potential prototype testing of other fish facility structures. Hence, contract documents will be prepared during FY01 to paint several of the components within the facility. A draft final report will be prepared on the entire separator project by the end of the fiscal year.

During FY02, painting (via construction contract) of components of the test separator facility at Ice Harbor will be completed. The final report will be published on the entire separator project.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete Installation of test components – McNary	April/2001
Complete Installation of lighting test components – Ice Harbor	April/2001
Biological Testing FY01 complete	July/2001
Complete contract document preparation for painting – Ice Harbor	August 2001
Complete Draft Final Report Separator Project	September 2001
Complete Final Report	December 2001
Complete paint contract	March 2002

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$250,000				

Note: Very rough cost estimate.

4. Issues

The actual cost of painting the facility is not known. The cost estimate presented is very rough.

5. RPA Action

Results from this separator research and development program will be incorporated into other programs and studies, specifically: 1) the McNary Juvenile Fish Improvements (action 34); 2) The Snake River Juvenile Fish Facility Improvements (action 53) and; 3) the Lower Granite Juvenile Bypass System (action 81).

- Action 53. "The Corps shall evaluate and implement structural and operational alternatives to improve juvenile transportation at the collector dams."

- Action 81. "The corps shall complete design for new juvenile bypass facilities at Lower Granite Dam, including enlarged orifices and bypass gallery, open-channel flow bypass, improved separator for juvenile fish separation by size, and improved fish distribution flumes and barge-loading facilities and shall proceed to construction as warranted."

- Action 95. "The Corps shall complete investigations of improved wet separator design in 2002. The Corps shall design and construct a new wet separator at McNary, Lower Monumental, and Little Goose dams, as warranted."

Pending the results of the 2001 research and 2002 Implementation Decision the development and construction of improved separators at Lower Monumental, McNary and Little Goose Dam are anticipated. The implementation schedule will be developed as part of the Implementation Decision and is not known at this time. Separator improvements for each site will be addressed under the McNary Juvenile fish Improvements (RPA 34) and Snake River Juvenile Fish Facility Improvements (RPA 53). The new design criteria for the separator will be incorporated in the Designs Memorandum for the new Lower Granite Fish Facility (RPA 81).

21. Juvenile Salmon Temperature Studies

Draft Multi-Year Plan

1. Project Information

- **Purpose/Objective** - Hydro management has changed thermal regimes in the Columbia River basin from that historically encountered under free-flowing conditions. For example, Snake River fall chinook outmigrates later in the summer when flows are low and water temperatures approach the lethal maximum. Since temperature drives many biological processes in fish, smolt physiology and performance may be compromised by chronic exposures to thermal stress. Disease susceptibility also increases with temperature. As a result, indirect temperature effects may cause substantial extra and delayed mortality to smolts passing through the juvenile bypass and collection facilities. Mortality may also increase with the added stress of transport or by having migration-prolonged in-river when conditions are poor. Evaluating the thermal effects on both migratory scenarios will provide information to improve the survival of juvenile chinook salmon. Identify physiological indicators of acute and chronic thermal stress.

  Cold-water releases from Dworshak Reservoir cause a decrease in the mid-level water temperature in Lower Granite Reservoir of 3-5^{o} C (Karr et al. 1998), which may be slowing the rate of feeding and growth of predators in the reservoir. Changing the temperature from 20.3 ^{o}C to 15.0 ^{o}C, as was observed in Lower Granite during a 24-d period in 1994 (Karr et al. 1998), reduced the expected rate of predation by smallmouth bass on salmonids from 1 g/d to 0.5 g/d, respectively, based on bioenergetic modeling.

  Currently the only mainstem temperature information that is available in near real time are scroll case readings and measurements taken from water quality instruments used to determine dissolved gas levels. The scroll case readings are only taken once a day and can vary depending on data collection methods.. The water quality instruments in the forebay are placed 15 ft deep directly in the middle of the dam or in the tailrace usually near the shore at 15 ft deep. Large temperature differences between these locations and other measurement sites have been noted from past studies (Karr et al. 98).

- **Descriptions** - Water temperature plays a crucial role in the management of Dworshak and Brownlee reservoirs for flow augmentation. Furthermore, temperature profile data could be correlated with adult radio telemetry studies that track both the locations of the adults as well as the depth at which they migrate. Adult tracking studies are currently ongoing for the 2000 migration season. This information would be valuable to determine potential trends in adult movements related to cool water flow augmentation. Similarly, sonic tag information will be available for juvenile migrants in the forebay from the 2000 spring evaluation in the end of year reports. A pilot study for sonic tags was conducted in 2000 at Lower Granite Dam forebay in conjunction with the surface bypass evaluation. The final report is scheduled for release during the last quarter of FY01.

2. Major Activities/Tasks

a. Evaluate and monitor the implementation of summer flow augmentation to optimize juvenile fall chinook salmon passage and survival through the Lower Granite reservoir.

b. Review existing data for salmonid distribution behavior in Lower Granite and other reservoirs, especially with respect to temperature preferences.

c. Monitor nearshore temperatures in Lower Granite Reservoir where predator-prey encounters likely occur.

d. Monitor temperature and depth occupied by predators in Lower Granite Reservoir during June-August, especially before, during, and after release of water from Dworshak Res.

e. Develop a spatially-explicit predator-prey model to quantify salmonid losses under different management scenarios.

f. Identify physiological indicators of acute and chronic thermal stress.

g. Identify performance-related changes of juvenile fall chinook salmon exposed to long-term sub-lethal temperatures and correlate to thermal exposure during dam passage.

h. Compare the physiological indicators of thermal stress and performance of in-river migrants and fall chinook salmon in the transportation system. (2002-2002) (McNary 2002, LGR 2003 and John Day 2004)

i. Estimate mortality of juvenile fall chinook resulting from the current range of temperature during in-river migration, bypass and transportation.

Milestone	**Date (Mo/Yr)**
Temperature Biological Indicator Impacts - Report Completion McNary	Sept / 2002
Temperature Impacts Biological Indicators - Report Complete LGR	Sept / 2003
Temperature Impacts Biological Indicators - Report Completion John Day	Sept / 2004
Evaluation of De-Stratification on Temperature Profiles at McNary - pilot	Sept / 2002
Temperature Monitoring –start	Sept 2002

3. Cost Estimate

FY02	**FY03**	**FY04**	**FY05**	**FY06**
$1005k	$750k*	$1250k	Pending	Pending

* Assumes continuation of disease evaluations and temperature monitoring at one or two sites, only.

4. Issues – Existing water and meteorological data may be inadequate for this purpose

5. RPA Action

- Action 141 - The Action Agencies shall evaluate juvenile fish condition due to disease in relation to high temperature impacts during critical migration periods. This evaluation should include monitoring summer migrants at lower Columbia and lower Snake river dams to clarify the possible link between temperature and fish disease and mortality. This information will be used to assess the long-term impacts of water temperature on juvenile fish survival."

- Action 142 - The Corps shall work through the regional forum process to identify and implement measures to address juvenile fish mortality associated with high summer temperatures at McNary Dam. As a starting point, the Corps shall assemble and analyze the temperature data that have been recorded in the McNary forebay, collection channel, and juvenile facilities. The Corps shall examine relationships among juvenile mortality, temperatures, river flow rates, and unit operations in detail. The Corps shall investigate the feasibility of developing a hydrothermal computational fluid dynamics model of the McNary forebay to evaluate the potential to determine optimal

powerhouse operations or structural modifications for minimizing thermal stress of juvenile salmon collected in the summer and to conduct a modeling program, if warranted.

- Action 105 - The Action Agencies shall develop a pilot study to assess the feasibility of enhancing the function of ecological communities to reduce predation losses and increase survival in reservoirs and the estuary.

- Action 143 - By June 30, 2001, the Action Agencies shall develop and coordinate with NMFS and EPA on a plan to model the water temperature effects of alternative Snake River operations. The modeling plan shall include a temperature data collection strategy developed in consultation with EPA, NMFS, and state and Tribal water quality agencies. The data collection strategy shall be sufficient to develop and operate the model and to document the effects of project operations.

- Action 199 - The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H.

23. Turbine Passage Survival Program (TSP)

Draft Multi-Year Plan
12 March 2001

1. Project Information

- **Purpose/Objective**

The Turbine Passage Survival Program (TSP) was developed to investigate means to improve the survival of juvenile salmon as they pass through Kaplan turbines located at Columbia and Snake River dams. The TSP is a joint Portland/Walla Walla District study. It is composed of two phases of study.

The Phase I - TSP was initiated with little detailed information on existing operation of the Kaplan turbines and fish survival on the Columbia and Snake River system. The objectives during this phase include: (a) gaining a better understanding of the turbine environment, (b) optimizing operation of the turbine for better fish passage, (c) identifying the most promising turbine modifications for improved fish passage, and (d) defining the best strategy for incorporating these improvement into rehabilitation programs.

Phase II – The TSP will take the information gathered in phase I and develop a plan for implementing design modifications into scheduled turbine rehabilitations. In addition, developmental and design work will be performed resulting in a prototype turbine to be tested at one of the main stem Columbia or Snake River dams. Additional testing on draft tube effects and tailrace egress will also be implemented to evaluate these portions of turbine passage.

- **Description**

In 1994, the COE completed the System Configuration Study (SCS) to investigate various improvements to the Columbia and Snake River hydrosystems. The two major items corresponding to turbine passage survival resulting from the SCS were the Turbine Passage Survival Workshop and the Turbine Basecase Report.

A draft of the Phase I report will be completed in October 2001 summarizing all work to date on the TSP. The report will also identify a detailed study plan for future Phase II work, to begin in FY02.

2. Major Activities/Tasks

The following tasks will be performed by NWW/NWP with close collaboration and coordination with regional fisheries agencies. Tasks 1-10 identify the work associated with finalizing the Phase I investigations. Tasks 11 - 15 are anticipated investigative work for the Phase II TSP.

Task 1. Conduct ongoing hydraulic modeling and prepare reports. WES (ERDC) will provide modeling support and associated reporting to complement biological testing currently scheduled and to obtain information to assist in planning for future tests.

Task 2. Develop a fish tracking model using drogues and live fish. This element will provide a representation of the specific routes fish take during passage and how these routes may vary behaviorally from inanimate representations.

Task 3. Develop and test physical model of Bonneville Powerhouse One with conventional and MGR runners. The model will be used to verify the passage routes that juvenile fish followed during the first biological test in winter 1999-2000 and for use with future studies, including CFD model development, draft tube evaluations and turbine performance/survivability comparisons.

Task 4. Plan and Conduct Second McNary Field Test. A plan of study and scope has been prepared \ to conduct the second biological test at McNary Powerhouse during FY02. This test will be conducted to incorporate operational, indirect and adult components into the test. These components were not evaluated during the first test in FY99.

Task 5. CFD model development. Computational Fluid Dynamics is a process that uses a numerical model to estimate and predict the characteristics of fluid flow. A CFD model will be developed for the turbine environment that can be calibrated with physical models. The CFD model will be able to evaluate the hydraulic effects of changes to turbine design or operation.

Task 6. Tail log slot closure plan. During the biological test of the MGR at Bonneville Powerhouse One, a problem was identified in the accidental trapping of fish in the tail log slot before the fish could enter the tailrace. This also occurred with the biological test at McNary Dam and is believed to be a problem at all the projects. Due to the potential significance of this problem, a solution was expedited during Phase I, which can be adapted at all the projects.

Task 7. Evaluation of draft tube/egress. Potential problems associated with the passage of juvenile salmonids from the turbine to the tailrace will be studied through physical models. It is believed that turbulence disorients the fish and makes them susceptible to predation.

Task 8. Adult sensor fish development. It is believed that a significant number of adult fish are being pulled back into the turbine as they pass the powerhouse. Sensor fish the size of adults would be developed for future testing.

Task 9. Prepare Phase I draft report. A draft report will be prepared documenting all facets of the entire Phase I of the Turbine Survival Program. A Phase I technical report will provide information about the Engineering, Hydraulic, and Biological Reports. This will serve as a basis for the final report in FY02, which will incorporate the results from the second biological test at the McNary Powerhouse.

Task 10. Support Activities. Provide support to other activities related to turbine passage. Including the turbine working group, the Department of Energy's AHT program and other similar groups.

Phase II

Task 11. Alternative machine design. Turbines of design other than the conventional Kaplan units on the Columbia River system, will continue to be analyzed for their potential biologic and engineering possibilities. These studies will take place over the several years (FY01-FY04). A diagonal-flow machine is scheduled to be tested at McNary by FY03.

Task 12 - Adult Studies. Included in the 1999 NMFS biological opinion was an item to investigate adult salmonid passage through turbines. Investigations will be performed to understand the extent of adult passage currently occurring through turbines. A plan will be developed based on this information and the adult sensor work and hydraulic model work to perform a biological test. The biological test on an existing unit will be performed.

Task 13 - Draft tube Studies. Model investigations of passage routes through existing draft tubes and modifications of these designs will be performed. Performance modeling of selected alternatives will be done and a design selected for prototype evaluation. The prototype will be constructed and performance and environmentally tested.

Task 14 - Egress Studies. Hydraulic modeling will be performed to investigate likely fish passage routes after exit from the draft tube. Similar work will be done using CFD modeling. Biological tests will be performed to evaluate the effects of any modifications in the operation or draft tube has on egress.

Task 15 - Phase II Report. A final report detailing all of the investigations will be prepared. Interim reports will be prepared at least bi-yearly.

Milestone(10pt)	**Date (Mo/Yr)** (10pt)
Complete Bonneville Model	May 2001
Complete Draft Phase I Report	October 2001
Conduct McNary 2nd year biological test	Jan-May 2002
Complete Final Phase I Report	December 2002

3. Cost Estimate ($1,000)

FY02	**FY03**	**FY04**	**FY05**	**FY06**
1,990	**1,360**	**2,128**	**3,126**	**3,583**

FY07	**FY08**	**FY09**	**FY10**	
3,200	**2,200**	**1,000**	**300**	

4. Issues

The FY02 budget assumes that we will have support funding from other interested agencies.

The FY03 budget assumes that the diagonal flow machine will be funded through other programs.

All years objectives and budgets are assumed that adequate funding will be available for previous years work. If funding shortfalls should occur, we will be unable to keep the schedule and achieve our objectives.

5. RPA Action

The following actions relating to the TSP are taken from the Endangered Species Act, Section 7, Biological Opinion on the Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin, dated December 21, 2000.

Action 59. "The Action Agencies, in coordination with the Regional Forum, shall determine the appropriate operating range of turbines equipped with minimum gap runners (MGR's) to increase survival of juvenile migrants passing through these new turbine designs."

Action 64. "The Corps shall continue the investigation of minimum gap runners at the Bonneville First Powerhouse."

Action 88. "The Corps and BPA, in coordination with the Fish Facility Design Review Work Group and the Fish Passage Improvement Through Turbines Technical Work Group, shall continue the program to improve turbine survival of juvenile and adult salmonids."

Action 89. "The Action Agencies shall investigate hydraulic and behavioral aspects of turbine passage by juvenile steelhead and salmon through turbines to develop biologically based turbine design and operating criteria. The Corps shall submit a report to NMFS stating the findings of the first phase of the Turbine Survival Program by October 2001. Annual progress reports will be provided after this date."

Action 90. " The Action Agencies shall examine the effects of draft tubes and powerhouse tailraces on the survival of fish passing through turbines."

Action 91. "The action Agencies shall remove all unneccessary obstructions in the higher velocity areas of the intake-to-draft tube sections of the turbine units."

Action 93. "The Action Agencies shall determine the number of adults passed through turbines, then, if warranted, investigate the survival of adult salmonid passage through turbines (including steelhead kelts)."

Action 111. "The Corps shall investigate and enumerate fallback of upstream migrant salmonids through turbine intakes at all lower Snake and lower Columbia River dams. The Corps shall implement corrective measures to reduce turbine mortality, as warranted."

24. Lower Granite Juvenile Bypass System

Multi-Year Plan Workplan

1. Project Information

- **Purpose/Objective**

The following was exerpted from the Endangered Species Act, Section 7, Biological Opinion on the Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin, dated December 21, 2000.

"Lower Granite is the first mainstem dam on the Snake River encountered by migrating juvenile salmon and steelhead. This location offers the greatest potential for collecting the largest number of smolts for transportation. Unlike the other dams, there is presently no way to separate juvenile fish by size. Size separation is believed to reduce stress and enhance long-term survival. Juvenile collection/bypass facilities at all of the other collector projects have been upgraded with state-of-the-art- improvements over the last decade. These improvements are necessary, while additional information on the benefits of transportation is collected."

- **Description**

In June of 1996, Feature Design Memorandum No. 43 (FDM 43) "Juvenile Bypass/Holding and Loading Facilities" was completed by the Corps which identified the modifications which would be made to the existing facility.

FDM 43 recommended the following modifications:

a. New fish orifices (one 12-inch-diameter and one 14-inch-diameter orifice per bulkhead slot).
b. A modified collection channel.
c. A new transportation channel linking the collection channel and the primary dewatering structure.
d. A new primary dewatering structure.
e. A new corrugated fish transport flume and pipe system.
f. Modified juvenile fish holding, loading, and bypass facilities (including a new separator and related features, new sample tanks, new fish transport flumes and pipes, and a new temporary research building).

Included in FDM 43, was a recommendation to investigate juvenile fish separator improvements for potential use at Lower Granite. This work was funded in FY97 and a report was prepared entitled "Letter Supplement Number 1 to FDM 43, Evaluation Separator". This Letter Supplement Number 1 recommended construction of a prototype test separator at Ice Harbor to evaluate various changes to fish separators to improve efficiencies of existing separators and to examine new potential methods of separation. In 1997-1998, a test separator was constructed at Ice Harbor. The test separator has been investigated biologically in FY99, FY00 and will be tested again in FY01. A final technical report is planned for completion in FY01. R*eference multiyear work plan entitled "Separator Evaluation"*.

Another modification described in FDM 43 was a new dewatering structure. A new design "Cylindrical Dewatering" is currently being constructed at McNary dam as a test structure for biological evaluation. The biological testing is scheduled for FY01 – FY03. If the results of this new technology are positive, then a cylindrical dewatering structure would be incorporated into the new JBS at Lower Granite. *Reference multiyear work plan "McNary Cylindrical Dewatering Prototype Evaluations"*.

FDM 43 also described the potential for incorporating a surface collection and bypass system as part of the JBS improvements. A prototype surface bypass and collection system (SBC) has also been constructed and biologically evaluated at Lower Granite dam over the past few years. Information has been presented to the region for decisions related to SBC.

A new report entitled "Lower Granite Juvenile Bypass System – Design Documentation Report" will be prepared which will replace the previous report (FDM 43). The Design Documentation Report (DDR) will address a new separator design, a new dewatering structure design and incorporation of surface bypass and collection into the new juvenile bypass system at Lower Granite. The DDR will also address a new construction schedule and cost estimate.

2. Major Activities/Tasks

Work will not begin on the DDR until October FY02 (assuming funding is available). This will allow completion of biological evaluations of the test separator at Ice Harbor and the test Cylindrical Dewatering structure at McNary. The DDR will require about one year to complete. Contract documents will be prepared in FY03 per regional decisions made based on recommendations from the DDR. Construction of these major modifications is expected to take about 18-24 months depending on recommended modifications. A post construction evaluation will be conducted to verify acceptable operation of the newly constructed facility. The following table illustrates the activities and estimated schedule.

Milestone	**Date (Mo/Yr)**
Complete Separator Evaluation at Ice Harbor (separate program)	September/2001
Complete Cylindrical Dewatering evaluations at McNary (separate program)	September/2001
Complete new Design Documentation Report	September/2002
Compete contract documents	September/2003
Complete Construction	September/2005
Complete Post Construction Evaluation	December/2005

3. Cost Estimate

FY02	**FY03**	**FY04**	**FY05**	**FY06**
$300k	$400k	$9325k	$10325k	$50k

Regional decisions concerning the surface collection and bypass system at Lower Granite may also effect schedules and associated costs. A new construction cost estimate will be prepared and presented in the letter supplement. Construction costs presented here reflect that presented in the old FDM 43.

4. Issues - Preparation of the DDR is dependent on funding, and timely completion of: 1) the test separator work, and; 2) the cylindrical dewatering biological evaluations. If schedules change in these programs, then a corresponding change in schedule will occur for the DDR. Regional decisions concerning the surface collection and bypass system at Lower Granite may also effect schedules and associated costs. A new construction cost estimate will be prepared and presented in the letter supplement. Construction costs presented here reflect that presented in the old FDM 43.

5. RPA Action

Action 81 - The Corps shall complete design for new juvenile bypass facilities at Lower Granite Dam, including enlarged orifices and bypass gallery, open-channel flow bypass, improved separator for juvenile separation by size, and improved fish distribution flumes and barge loading facilities and shall proceed to construction as warranted.

25. Lower Monumental Juvenile Bypass System Outfall

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - The existing outfall site has been judged to be poor because the tailrace currents have been observed under certain operations to flow upstream toward the powerhouse. The outfall facilities have also recently been damaged by a transport barge. If needed, a new outfall shall be designed to return both PIT-tagged fish and primary bypass to the river.

- **Description -** This project is being addressed concurrently with the Lower Monumental Gas Fast-Track (Deflectors). A physical hydraulic model is being tested at WES in conjunction with spillway stilling basin erosion and deflector studies. Documentation for the model tests include particle tracking data which gives velocity data throughout the tailrace area. In particular, data will be collected in the vicinty of the existing outfall. Changes to spill patterns, operations (turbine vs spillway) to address tailrace egress issues, and changes to the spillway (deflectors, powerhouse spillway divider wall etc.) may have impacts on water velocities at the current outfall location and other locations. The approach is to resolve the erosion issues, and define all deflector issues including tailrace egress etc. before settling on changing the location of the current outfall. If a better outfall site is defined per the model study investigations, then a design documentation report will be prepared addressing design and construction issues including costs and schedule for relocating the outfall. If a better outfall site is not found, then a summary paper will be prepared documenting the modeling results.

2. Major Activities/Tasks –

The activities listed below assume that it will be necessary to relocate the existing outfall site to a different location. In FY01, modeling of the deflectors and erosion of the stilling basin is being performed and is anticipated to be completed in September 2001. During FY02, a design documentation report (DDR) will be prepared addressing necessary modifications to the facility to accommodate the relocation. The DDR will address planning, engineering, design and construction cost estimates. Upon completion of the DDR, contract documents will be prepared and a construction contract awarded to facilitate the relocation in FY03.

Milestone	Date (Mo/Yr)
Complete model testing	Oct/2001
Complete DDR	Mar/2002
Complete P&S	Aug/2002
Award Contract	Oct/2002
Complete Construction	Mar/2003

3. Cost Estimate

Cost estimates proposed are placeholders subject to significant change pending development of better information.

FY02	FY03	FY04	FY05	FY06
$350,000	**$1,000,000**			

4. **Issues** - This workplan assumes that funding is available for initating the DDR, plans and specifications and construction. This plan also assumes that a new and better location can be identified. Changes to these assumptions will change this proposed work plan. Cost estimates proposed are placeholders subject to significant change pending development of better information.

5. **RPA Action –**
   - Action 76 - The Corps shall investigate, design, and construct, as warranted, a new juvenile bypass outfall at Lower Monumental Dam. Investigations shall be conducted in conjunction with spillway deflector and spill pattern optimization studies

26. Little Goose Pit-Tag System Modification

Multi-Year Plan

1. Project Information

- **Purpose/Objective** Pit-tag systems have become a critical component of our ability to monitor passage of juvenile fish through our projects. This information is used to make important operational decisions related to juvenile passage at our projects. The importance of this information makes it imperative that the systems provide high quality passage conditions consistent with the latest bypass technology.

- **Description** - The changes identified at Little Goose have been developed through close coordination with the fish agencies and the project. The following modifications should be incorporated into the system before the 2002 fish passage season.

  1) Bypass both PIT-tag headboxes.
     - Remove old headboxes.
     - New grating for area where headboxes were located.
     - Remove fish transport piping from head boxes to holding tank.
     - Cap off the water supply pipes feeding the old headboxes.

  2) Combine both A-side and B-side PIT-tag fish into a single conduit.
     - Provide new transition funnel out of each dropgate box.
     - Add base (flush) flow at the upstream end of each "dropgate pan".
     - Wide, sweeping bends with A-side conjunction on top of B-side flow.

  3) Provide a dewatering unit just downstream of flow junction to remove excess flows due to dropgate operation. This is to reduce velocity variations at the new PIT-tag activated, 3-way switch gate (to be provided by NMFS).
     - Perforated, round bottom (10-inch diameter) plate; (1/8-inch dia. holes).
     - Adjustable side weirs to drain away excess flows. Weirs should be set to remove only a slight amount of flow when the base flush flow has been adjusted to provide good conditions in the conduits upstream and desirable conditions downstream to the switchgate.
     - Provide drain piping from dewatering unit to facility drain system.

  4) Provide an access platform at the new dewatering unit.

  5) Provide a 10-inch diameter transport pipe to the holding tank area.

  6) **(Provided by NMFS)** Three-way, select by code PIT-tag detector and switchgate (side-by-side, flexible hose type).

  7) Provide a platform extension to access to the new PIT-tag detector at switchgate.

  8) **(Provided by NMFS)** Reconfigure holding tank. ***6-inch release piping from the holding tanks will remain unchanged.*** Also, the blue plywood storage shed on the west side of the holding tank will have to be moved or modified because it is in the path of the new 10-inch river release pipe that will run just above the holding tank. Provide a new 10-inch pipe for the straight through route from the holding tank area to join the river release pipes downstream of barge loading area.

- Provide support for a PIT-tag detector just downstream of the holding tank area on the new, river release pipe.
- Provide a vertical connection into one (or possibly both) of the 10-inch river release lines. The connection should make a shallow angle into the existing pipe (preferably 10 to 15^{O}; 20^{O} maximum).
- Potentially, a switchgate with vertical connections into both release pipes will be provided to allow flexibility to use either release pipe. An evaluation of current discharges in the existing river release pipes is needed. It may turn out that a dewatering unit prior to the switchgate will be required to reduce flows so that the capacity of the existing river release pipes are not exceeded or a new, separate release pipe will be needed.

9) Modify the existing vertical connection of the 6-inch pipe into the 10-inch pipe to make a shallower junction angle (preferably 10 to 15^{O}; 20^{O} maximum).

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Award Construction Contract	Oct/2001
Construction Complete	March/2002
Post Construction Evaluation Complete	7/2002

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$525k				

4. Issues

5. RPA Action

- RPA 53 – The Corps shall evaluate and implement structural and operational alternatives to improve juvenile transportation at the collector dams.
- RPA 87 – The Corps and BPA shall assess less-intrusive PIT-tag interrogation methods at FCRPS juvenile bypass systems with interrogation sites.
- RPA 94 – The Corps shall continue to evaluate the need for improvements of the existing ……, and bypass facilities at the four Lower Snake River projects

27. McNary Cylindrical Dewatering Prototype Evaluations

Multi-Year Plan

1. Project Information

- **Purpose/Objective**: Fish facilities have utilized submerged floor and side screen dewatering systems for most dewatering applications. Most systems on the Lower Snake river and McNary have proven to be problematic, both in terms of their effectiveness and mechanical reliability. At McNary in 1996 the floor screen system failed when the cleaning systems could not keep up with the debris accumulations. Due to the considerable problems experienced at the facilities, a new prototype cylindrical dewatering system has been constructed and is planned for testing in 2001/02. McNary project was identified for prototype testing due to debris loads of both fine aquatic (generally from the Columbia system) and coarse woody debris (generally from the Lower Snake). Results of the prototype tests may have applications at new or existing bypass and collection systems.

- **Description -** In FY01, a prototype system will test the cylindrical wedge-wire screen system, which would pass fish through the interior of the cylindrical screen and dewater through the drum. The drum would slowly rotate so the material can be easily cleaned off the surface, with some of the material being collected and removed. The system should reduce or eliminate screen-plugging problems. Advantages of the system include: greater wetted screen surface for lower through-screen velocities; larger total screen area allows the system to handle greater debris volumes; allows for above-water visual inspection during operation. Part of the screen is always out of the water and can utilize a simple, effective, above-water-level screen cleaning system. Some debris can be removed at the source and not be passed on through the fish facility. Recognizing there could be potential applications for any new or existing dewatering structures, a 1/4-scale pilot test facility has been constructed at McNary. The system is planned for initial debris and biological testing in FY 01/02.

2. Major Activities/Tasks –

Milestone	Date (Mo/Yr
FY 2002	
Reference data from the FY01 testing. Make corrections and improvements, if necessary	10/01 - 9/02
Conduct verification debris and biological tests, if warranted.	4/02 – 8/02
Prepare feasibility report to identify potential applications at LSR and McNary. Coordinate with NWP for potential applications at Other federal hydropower projects.	10/01 –9/02

FY 2003	
Prepare P&S contract to remove or relocate the prototype.	10/02 – 4/03
NMFS prepare final biological report with recommendations.	10/02 – 9/03
Plan for feasibility recommendations, as warranted.	9/03 +
FY 2004	
Issue contract to remove or relocate prototype. Leave water supply line for project uses. Repair deck areas, return area to original condition.	10/03 – 3/04
Initiate/develop technology at other sites as warranted. Original anticipated application for fish facility improvements at Lower Granite Dam.	10/03 +

3. Cost Estimate

FY02	**FY03**	**FY04**	**FY05**	**FY06**
540K	**255K**	**243K**	**0**	**0**

4. Issues Work plan based on limited testing protocol for the prototype structure. Future modifications and changes necessary cannot be anticipated or budgeted, so additional funds may be necessary depending on regional desires for testing, future uses, or relocation to another location.

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5. RPA Action –

RPA reference	**RPA summarized text, D=direct relationship, I = indirect relationship**	
Action 52:	The Corps shall identify and implement improvements to the transportation program.	I
Action 53:	The Corps shall evaluate and implement structural and operational alternatives to improve juvenile transportation at the collector dams.	I
Action 74:	The Corps shall continue evaluations to assess the need for improvements of the existing intake screens, gatewell vertical barrier screen cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at McNary to determine where improvements are necessary to reduce problems experienced during the 1996 flood, increase fish survival, and resolve holding and loading facility problems, including raceway jumping by juvenile salmon and steelhead and debris plugging of bypass lines. Additionally, the Corps shall evaluate whether the existing juvenile bypass system outfall should be relocated.	D
Action 81:	The Corps shall complete design for new juvenile bypass facilities at Lower Granite Dam, including enlarged orifices and bypass gallery, open-channel flow bypass, improved separator for juvenile separation by size, and improved fish distribution flumes and barge-loading facilities and shall proceed to construction, as warranted.	I

RPA reference	RPA summarized text, D=direct relationship, I = indirect relationship	
Action 94:	The Corps shall continue to evaluate the need for improvements of the existing intake screens, gatewell vertical barrier screens' cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at the four lower Snake River hydropower projects.	D
Action 146:	The Corps shall address debris-handling needs and continue to assess more efficient and effective debris-handling techniques to ensure that the performance of both new and old fish passage facilities will not be compromised.	D

28. McNary Juvenile Fish Facility Debris

Multi-Year Plan

1. Project Information

- **Purpose/Objective**: This work plan will identify actions recommended to reduce and alleviate debris accumulations and problems experienced at McNary juvenile fish facility.

  Background: The new fish facility at McNary became operational in 1994. In 1996 and 1997, extended submerged bar screens (ESBS) and vertical barrier screens (VBS) were installed. The new ESBS were twice as long as the previous screens, and divert substantially more flow into the gatewell. The ESBS and VBS systems have proven to increase fish guidance and reduce fish mortality by diverting them out of the turbine intakes, and into a bypass and collection system.

  In 1996, after initial installation of twelve ESBS at McNary and coupled with an extreme debris load in the Snake and Columbia rivers, the fish facilities on the Snake and at McNary were overwhelmed with debris, especially at projects with the new ESBS and VBS screens. At McNary, the debris plugged the VBS, failed (collapsed) the floor screen system, and substantial effort was necessary at the facility raceways to prevent debris for plugging the systems and harming juvenile fish. As a response to the experiences, NWW prepared a report "Lower Snake and Columbia Rivers, Debris Control Study, Phase I report, which identified several "short term" actions necessary to operate the new fish facilities.

  Many of the measures identified in the report were implemented prior to the 1997 fish season. In 1997, another high debris load was present in the system, and the projects continued to struggle to operate the facilities. In February of 1997, a draft report was prepared by NWW entitled "Lower Snake And Columbia Rivers, Debris Control Study, Phase III report. (Phase II was the implementation of the Phase I recommendations). The report detailed "long term" actions necessary to reduce the debris problems. The following is a summary of the actions identified in the report, and status of the actions:

  - Install a trash boom at Little Goose: Status: Construction completed in 2001.
  - Debris removal equipment – McNary : Status: Recommendation identified in the report " McNary Dam, Debris Boom Analysis and Alternatives, March 2000". Debris removal craft recommended to remove debris in the forebay, with minimal distrubance to the debris mat. Project personnel are now researching appropriate equipment, for possible purchase in FY 02. Until a solution is implemented, funds have been necessary to contract forebay cleaning, which substantially reduces the debris loads in collection channel and the fish facilities.
  - Replace juvenile collection channel stoplogs: Status: Construction completed in 2001.
  - Install orifice shelters – McNary: Status: Tests were conducted in 1998/99. Results did not show a debris benefit, however the tests indicate possible orifice passage efficiency benefit. Additional VBS modeling is being conducted at WES to replicate debris actions and accumulations on VBS panels, then look for alternatives design

solutions to reduce the plugging. The project staff at McNary conduct daily inspections of the gatewells, and need to physically clean the VBS by pulling them out of the slot and washing the debris off the panels. This has been absolutely necessary to prevent the screens from plugging to a point of fish injury or failure of the panels. Funds will be required every season to clean the panels until a more automated system can be installed.

- Orifice improvements- Granite/Goose: Status: Installed automated orifice backflush systems in 2000. Need to test vibration sensors (accelerometers) on the orifices to sense orifice blockages and initiate backflush.
- Upgrade Dewater Screen Panels – McNary: Status: Replace the floor dewater panels in 1999 with perpendicular bar screen panels (versus parallel). These have proven to be essentially self-cleaning panels.
- Cylindrical Dewatering Prototype – McNary: Status: Prototype construction is completed. Plan for debris and biological tests in 2001/2002. See "McNary Cylindrical Dewatering Prototype Evaluations" Multi-Year work plan.

- **Description –** Most of the actions identified have been implemented at the facilities. Remaining actions are:
  Gatewell Debris: For FY01, a strategy and plan to reduce the effects of debris and improve the long-term operation of the VBS and gatewell system will be developed. Model studies are being conducted to develop other methods of debris control to reduce debris accumulations on the VBS. Any promising alternatives will be developed and tested in the field at McNary in FY02. A report will be prepared to document the measures and determined benefits, to ensure coordination with the region and Lower Columbia river projects
  Forebay Debris: It is absolutely necessary to remove the debris from the forebay to reduce the loads at the facilities. Contracts have been issued every fish season since 1997. If the debris removal craft can be procured and proves to be effective, funds for yearly contracts will be necessary to reduce risk to fish and protect the facility operations.
  Gatewell Debris Cleaning: Until automated solutions can be developed, it is also absolutely necessary to physically clean the VBS during the fish season. The cleaning takes place from April to late November. Crews are necessary to monitor the head differentials, which indicate if screens are plugging, then pulled and the debris is washed off.

2. Major Activities/Tasks –

Milestone	Date (Mo/Yr
FY 2002	
Finalize WES modeling – identify solutions, prepare report	11/01 – 6/02
Forebay debris contracts (Unless DRC is purchased) budget for purchase of the craft (800K)	4/02 – 11/02
Gatewell debris cleaning	4/02 – 11/02

Milestone	Date (Mo/Yr
FY 2003	
Install prototype gatewell systems (if identified in the report)	FY03
Forebay debris contracts (Unless DRC is purchased)	4/03 – 11/03
Gatewell debris cleaning	4/03 – 11/03
FY 2004	
Design final gatewell systems (if supported by prototype testing)	FY 04
Forebay debris contracts (Unless DRC is purchased)	4/04 – 11/04
Gatewell debris cleaning	4/04 – 11/04
FY 2005	
Install final gatewell systems	FY 05
Forebay debris contracts (Unless DRC is purchased)	4/05 – 11/05
Gatewell debris cleaning	4/05 – 11/05
FY 2006	
Post Const evaluations - final gatewell systems	FY 06
Forebay debris contracts (Unless DRC is purchased)	4/06 – 11/06
Gatewell debris cleaning	4/06 – 11/06

3. **Cost Estimate :** Placeholder funds. Funds to clean forebay and gatewells necessary if other actions cannot be implemented.

FY02	FY03	FY04	FY05	FY06
1000K	**450K**	**350K**	**1500K**	**500K**

4. **Issues:** RPA 99 may reduce or eliminate actions after 2003, depending on decisions on RSW's and developments. Depending on river conditions and use priorities, the fisheries agencies may determine both extended screens and RSW's may be necessary at Lower Monumental. The scenarios are; low flow years (maximize transport spring and summer); typical flow years to maximize in-river passage (spring) and transport (summer); and unusually high flow years, where in-rive passage may predominate.

5. **RPA Action –**

RPA reference	**RPA summarized text, D=direct relationship, I = indirect relationship**	
Action 52:	The Corps shall identify and implement improvements to the transportation program.	I
Action 74:	The Corps shall continue evaluations to assess the need for improvements of the existing intake screens, gatewell vertical barrier screen cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at McNary to determine where improvements are necessary to reduce problems experienced during the 1996 flood, increase fish survival, and resolve holding and loading facility	D

RPA reference	RPA summarized text, D=direct relationship, I = indirect relationship	
	problems, including raceway jumping by juvenile salmon and steelhead and debris plugging of bypass lines. Additionally, the Corps shall evaluate whether the existing juvenile bypass system outfall should be relocated.	
Action 78:	The Corps shall initiate design development and testing of extended submerged intake screens and vertical barrier screens at Lower Monumental Dam and construct units as warranted.	I
Action 94:	The Corps shall continue to evaluate the need for improvements of the existing intake screens, gatewell vertical barrier screens' cleaning system, and bypass facilities (including debris containment and removal systems, separation, sampling, loading, and outfall facilities) at the four lower Snake River hydropower projects.	I

29. Little Goose Trash Boom

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - Large quantities of floating debris tend to collect in the forebays of the lower Snake River dams. In addition to causing hazards to hydroelectric facility equipment, debris can be entrained in the juvenile bypass system, causing physical trauma to migrating salmonids. In an effort to divert debris away from the powerhouse at Little Goose Dam (and, in turn, away from the juvenile collection facility), a floating debris diversion structure (trash boom) was installed. It is not currently known if predatory fish, known to cause significant losses to migrating juvenile salmonids, will concentrate around the trash boom itself and/or the debris that may collect there. This objective is to determine the effect of the trash boom on the abundance and distribution of predatory resident fishes in the forebay of Little Goose Dam. Work is to be conducted in high and low flow years, corresponding to high and low amounts of floating debris. Funding is through the FCRMP.

- **Description –** The Corps has developed criteria for initiating debris removal at the new log boom. Coordination with NMFS occurred at an FPOM meeting held in the second quarter of FY01. Criteria established was 2 surface acres of debris in the spring and 1 surface acre in summer to begin removal of floating debris (personal communication Dave Hurson).

  The installation of the new Trash Boom at Little Goose Dam began in September of 2000. The first phase of the assessment of predator aggregation began prior to the installation of the floating boom and determined the abundance of predatory fish in the forebay of Little Goose Dam. The assessment of the predatory population was made using a mark recapture study conducted through November 2000. The second phase will be conducted in FY01 and will determine the abundance of predators in the forebay post- boom installation. Data collection will be from March through November 2001 in the same areas of the forebay with the addition of sampling effort around the boom itself. The expected low water year for 2001 is expected to fulfill the requirement for evaluation in low water years. Research for a high flow year will be scheduled based on anticipated occurrence. An additional option would be to conduct a radiotelemetry study of predatory fish to determine distribution in the forebay.

  Previous related work was conducted by Bjornn et al. 1999 and Bennett et al. 1999. Bjornn reported that the distribution of radio-tagged Smallmouth Bass and Northern Pikeminnow in the forebay of Lower Granite Dam occurred primarily along the shorelines during the smolt outmigration. Very few fish were located near the trash boom that was in place. Bennett reported that catch per unit effort for Northern Pikeminnow in the Lower Granite Dam forebay boat restricted zone and the forebay itself was lower than any other sampling location in the Lower Granite Reservoir. In addition, overall abundance of Smallmouth Bass was highest in the forebay of Lower Granite Dam, but had the lowest catch per unit effort.

2. **Major Activities/Tasks –** The major tasks include completing fieldwork for FY01 and completion of the report in FY02.

Milestone	Date (Mo/Yr)
Conduct/Complete Low Flow Sampling at Little Goose Trash Boom	November/2001
Complete Final Report	April/2002
Conduct/Complete High Flow Sampling at Little Goose Trash Boom	November/2004
Complete Final Report	April/2005
Radiotelemetry Study	November/2003
Complete	April/2004

3. **Cost Estimate**

FY02	FY03	FY04	FY05	FY06
460K	200K	460K	200K	

4. **Issues** – If significant numbers of predators are using the trash boom and/or the collected debris as cover, a reassessment of the alignment of the boom and/or the debris removal criteria may need to be conducted.

5. **RPA Action**

- Action 79 - The Corps shall conduct a post-construction evaluation of the new debris containment boom at Little Goose to monitor populations and behavior of aquatic predators when debris accumulates at the log boom.

- Action 199 - The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H.

30. Ice Harbor Spillway Survival Study

Multi-Year Plan

1. Project Information

Purpose/Objective – Passage through the hydroprojects via the spillway provides a route of passage that allows fish to avoid turbine mortality and reduces forebay delay, thus reducing opportunities of forebay predation. However, spill levels, patterns and spill duration to provide the best conditions for smolts (dissolved gas levels, injury, tailrace predation and egress flows) must be balance with the negative impacts of high spill on adult salmon passage, fallback and water quality.

Spillway passage through In 1998 the modifications to the Ice Harbor Dam spillway were completed with flow deflectors on each of eight spillways and the construction of an adult fishway training wall to divert spill flows away from the adult fishway entrances. Biological evaluations have not been conducted to verify the performance of the modifications, specifically spillway survival, since the construction of these improvements. Thus, efforts are focused on confirming spillway passage survival for juvenile salmon under the normal range of project operations and on documenting the impact of the new adult fishway training wall on adult salmon fishway entrance behavior and passage through Ice Harbor Dam.

Also, the eddy that forms in front of the Ice Harbor powerhouse during spill has become more severe since the construction of the flow deflectors. The flows in front of the powerhouse are drawn toward the stilling basin under the spill. This eddy has been suspected of increasing the levels of dissolved gas and passage times of juvenile salmon through the tailrace. Thus, exposing the juvenile salmon to poor water conditions and potentially higher levels of predation at the project.

Complicating passage issues is the recent increase in the level of daytime spill at the Snake River hydroprojects up to the gas cap. Spill efficiency and effectiveness studies conducted in 1997 and 1999 indicated that increased levels of spill do not necessarily increase the efficiency of spill passage and appear to decrease the effectiveness of passage through spill. Other potential impacts of the increased daytime spill are to adult passage behavior, passage rates and increased adult fallback. Fallback may have a serious accumulative impacts of delay that effects spawning success and productivity of the adult salmon.

Survival studies have been conducted in 1999 for indication of immediate levels of survival and again in 2000 for longer term survival. Although the survival study in 2000 was compromised due to equipment failure the limited data indicates comparatively high survival for the spring summer chinook. However the same is not true for fall chinook survival through the spillway compared to a tailrace release group.

Description – Spill operations at Ice Harbor include 24 hr spill with the night time spill limited to the total dissolved gas cap as measured downstream and daytime spill is limited 45 kcfs for adult passage. This project uses radio telemetry and PIT tag to assess near term survival, comparative survival, tailrace egress and forebay delay under the current spill operation at Ice Harbor for spring/summer chinook and fall chinook.

2. Major Activities/Tasks -

a. Evaluate Ice Harbor passage distribution and eddy passage through the use of radio tags. Conduct spring chinook in FY01 and reassess fall chinook survival through spill by re-locating the tailrace control release.

b. Evaluate spillway survival at Ice Harbor (including a comparative evaluation of increased spill recommendations prior to implementation). Telemetry shall be used to partition survival through Ice Harbor to McNary Dam. A comparison of methodology (radio tags versus PIT tags) shall be incorporated into the spillway passage survival study to confirm the reliability of the telemetry data.

c. Evaluate the effects of eight flow deflectors on adult passage rates, entrance usage, and fallback through spill. Correlate entrance behavior to deflector and training wall effects.

d. Continue to evaluate spill effectiveness and efficiency and spillway passage survival (versus specific spillbay passage survival) at Ice Harbor.

Milestone	**Date (Mo/Yr)**
	March 2002
	March 2002
	March 2002

3. Cost Estimate

FY02	**FY03**	**FY04**	**FY05**	**FY06**
950,000	**550,000**			

4. Issues – Low flows and involuntary spill may delay these evaluations. This work requires special spill patterns, spill levels and duration to appropriately evaluate spill effectiveness and efficiency.

5. RPA Action – The following actions relating to the spill evaluations are quoted from the Endangered Species Act, Section 7, Biological Opinion on the Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin, dated December 21, 2000.

Directly Supports Reasonable and Prudent Alternative:

Action 82: "The Action Agencies, in coordination with NMFS through the annual planning process, shall investigate the spillway passage survival of juvenile salmonids at appropriate FCRPS dams. These investigations shall assess the effect of spill patterns and per-bay spill volumes on fish survival, across a range of flow conditions. The Action Agencies shall develop a phased approach (including costs and schedules) and set priorities, in consultation with NMFS in the annual planning process, to continue spillway passage survival studies in 2001 and future years."

Action 83: "The Action Agencies, in coordination with NMFS through the annual planning process, shall evaluate the effect of spill duration and volume on spillway effectiveness (percent of total project passage via spill), spill efficiency (fish per unit flow), forebay residence time, and total project and system survival of juvenile steelhead and salmon passing FCRPS dams. Studies shall include both

collector and non-collector projects. Adult passage considerations and potential adult fallback shall also be considered in study designs. Little Goose and Lower Granite dams shall be specifically considered for daytime spill studies. An overall phased study approach for spill evaluations will be determined in the 1- and 5-year implementation plans."

Supports Elements Under Reasonable and Prudent Alternative:

Action 134: "The Corps shall continue the spillway deflector optimization program at each FCRPS project and implement it, as warranted. The Corps and BPA shall conduct physical and biological evaluations to ensure optimum gas abatement and fish passage conditions. Implementation decisions will be based on the effect of spill duration and volume on TDG, spillway effectiveness, spill efficiency, forebay residence time, and total project and system survival of juvenile salmon and steelhead passing FCRPS dams."

Action 135: "The Corps shall include evaluations of divider walls at each FCRPS project in the spillway deflector optimization program. Design development and construction of the divider walls would begin only after coordination within the annual planning process, and only if warranted."

Action 199: "The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H."

31. McNary Spillway Survival Study

RPA 82 and RPA 83

Draft Multi-Year Plan

17 February 2001

1. Project Information

Purpose/Objective –Passage through the hydroprojects via the spillway provides a route of passage that allows fish to avoid turbine mortality and reduces forebay delay, thus reducing opportunities of forebay predation. However, spill levels, patterns and spill duration to provide the best conditions for smolts (dissolved gas levels, injury, tailrace predation and egress flows) must be balance with the negative impacts of high spill on adult salmon passage, fallback and water quality. Specifically at McNary, during normal and high flow years, juvenile chinook are not transported but passed through the juvenile fish bypass system or the spillway until summer conditions prevail. Thus, spill patterns and levels are used not only to improve the hydraulic conditions for fish passing through the spillway but also fish entering the tailrace via the juvenile fish facility outfall.

During spill flows in the tailrace of the powerhouse are drawn toward the stilling basin under the spill flows. This may create an eddy that may increase the levels of dissolved gas and passage times of juvenile salmon through the tailrace. Thus, exposing the juvenile salmon to poor water conditions and potentially higher levels of predation at the project.

Complicating passage issues is the recent interest in increasing the level of daytime spill at the hydroprojects up to the gas cap. In general, spill efficiency and effectiveness studies conducted in the late 1990s indicated that increased levels of spill do not necessarily increase the efficiency of spill passage and may decrease the effectiveness of passage through spill. Other potential impacts of the increased daytime spill are to adult passage behavior, passage rates and increased adult fallback. Fallback may have serious accumulative impacts of delay that effects spawning success and productivity of the adult salmon.

Description – Spill operations at McNary are 50% of total instantaneous discharge for 12 hours per day. The gas cap is reached at about 135 kcfs. Currently 18 of the 21 operational spillbays have deflectors. The focus of this effort is to conduct juvenile salmon spillway efficiency and effectiveness evaluation and spillway deflector optimization evaluations. Currently spill is conducted at nighttime to reduce impacts to adult salmon migration.

The planned addition of flow deflectors or modifications to their designs will help reduce the level of total dissolved gas supersaturation levels downstream of McNary while providing for better passage conditions for juvenile salmon. Deflector improvements will provide benefits in reduced TDG during involuntary spill events and a powerhouse/spillway divider wall will reduce TDG downstream during spillway operations. A physical hydraulic model of the tailrace hydraulic conditions at McNary will be used to help develop spill patterns to achieve acceptable tailrace hydraulic conditions for both adult fish passage and juvenile fish egress from the tailrace area. Depending on the results of WES modeling of potential daytime spill patterns for juvenile passage, future objective of this work will be to evaluate these changes on adult passage, fallback. Summer spill conditions to help egress and debris movement have been recommended, thus juvenile and adult salmon impacts will be evaluated for new operations.

2. Major Activities/Tasks –

a. Evaluate McNary passage distribution and eddy passage through the use of radio tags. Conduct spring chinook and fall chinook survival.

b. Statistically determine the route-specific relative survival of juvenile spring and summer chinook, steelhead and fall chinook passing through each route (spill, facility and bypass, and turbine) under Biological Opinion operations.

c. Evaluate cause-and-effect mechanisms for partitioning survival results including tailrace egress, physical injury due to exposure to structure or hydraulic turbulence and disorientation increasing exposure to predators.

d. Estimate the forebay retention time under 12 hour versus 24 hour spill.

e. Evaluate the effects of spill operations before and after construction of flow deflectors on adult passage rates, entrance usage, and fallback through spill. Correlate entrance behavior to deflector and training wall effects.

f. Continue to evaluate spill effectiveness and efficiency and spillway passage survival (versus specific spillbay passage survival) at McNary. Pending new spill operations, estimate the spill efficiency and effectiveness under the new spill patterns for 12 hour versus 24 hour spill.

g. Determine the seasonal and diel variation of turbine, spill, and bypass passage proportions of the BiOp operations. Hydroacoustics and radio telemetry will likely be required.

h. Estimate total project survival by combining survival estimates with the passage ratios estimated.

Milestone	**Date (Mo/Yr)**
	March 2002
	March 2002
	March 2002

2. Cost Estimate

FY02	**FY03**	**FY04**	**FY05**	**FY06**
950,000	**550,000**			

3. Issues – Low flows and involuntary spill may delay these evaluations. This work requires special spill patterns, spill levels and duration to appropriately evaluate spill effectiveness and efficiency.

4. RPA Action – The following actions relating to the spill studies are quoted from the Endangered Species Act, Section 7, Biological Opinion on the Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin, dated December 21, 2000.

Directly Supports Reasonable and Prudent Alternative:
Action 82: "The Action Agencies, in coordination with NMFS through the annual planning process, shall investigate the spillway passage survival of juvenile salmonids at appropriate FCRPS dams. These investigations shall assess the effect of spill patterns and per-bay spill volumes on fish survival, across a range of flow conditions. The Action Agencies shall develop a phased approach (including costs and

schedules) and set priorities, in consultation with NMFS in the annual planning process, to continue spillway passage survival studies in 2001 and future years."

Action 83: "The Action Agencies, in coordination with NMFS through the annual planning process, shall evaluate the effect of spill duration and volume on spillway effectiveness (percent of total project passage via spill), spill efficiency (fish per unit flow), forebay residence time, and total project and system survival of juvenile steelhead and salmon passing FCRPS dams. Studies shall include both collector and non-collector projects. Adult passage considerations and potential adult fallback shall also be considered in study designs. Little Goose and Lower Granite dams shall be specifically considered for daytime spill studies. An overall phased study approach for spill evaluations will be determined in the 1- and 5-year implementation plans."

Supports Elements Under Reasonable and Prudent Alternative:

Action 134: "The Corps shall continue the spillway deflector optimization program at each FCRPS project and implement it, as warranted. The Corps and BPA shall conduct physical and biological evaluations to ensure optimum gas abatement and fish passage conditions. Implementation decisions will be based on the effect of spill duration and volume on TDG, spillway effectiveness, spill efficiency, forebay residence time, and total project and system survival of juvenile salmon and steelhead passing FCRPS dams."

Action 135: "The Corps shall include evaluations of divider walls at each FCRPS project in the spillway deflector optimization program. Design development and construction of the divider walls would begin only after coordination within the annual planning process, and only if warranted."

Action 199: "The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H."

32. The Dalles Project Survival Study

DRAFT Multi-Year Plan
8 March, 2001

1. Project Information

- **Purpose/Objective**

The purpose of survival studies at The Dalles Dam is to determine the best project configuration for fish passage. An important element of this program will be to ascertain whether survival improvements can be achieved through spillway, stilling basin, and turbine modifications.

- **Description**

The current juvenile fish passage strategy for The Dalles Dam is to maximize fish passage through the spillway and Ice and Trash Sluiceway. Recent fish passage efficiency evaluations suggests that the spillway is highly effective at passing a large proportion of the juvenile run: at 40% juvenile spill it is estimated 77% to 85% of the run passes the dam via the spillway. Under this same operation, an additional 6% to 11% of the run passes via the sluiceway.

Since 1996, survival tests have been conducted at The Dalles Dam. Early tests suggested that spillway survival was lower than expected, and later tests determined that percentage of spill affects survival, with 30% spill resulting in higher survival than 64% spill. As a result of these findings, regional salmon managers have reduced the percent spill from 64% to 40%. Spillway survival, while improved at 30-40% compared to 64%, is still unacceptably low for a primary passage route, however. In addition to spillway survival, turbine and sluiceway survival has been tested. Turbine survival rates were much lower than expected, based on estimates from other dams. Sluiceway survival rates varied by year and season, with unacceptably low survival (89%) tested in the summer of 1998.

Previous evaluations attempted to measure survival improvements under various spill levels. These tests did not enable us to identify mechanisms for observed mortality (e.g. predation or mechanical injury). The next important step to take is to determine whether survival rates at The Dalles Dam can be improved through spillway, sluiceway and turbine unit modifications. The scope of survival studies has shifted from developing point survival estimates under various operating conditions, to identifying mechanisms for mortality. This information will be used to guide spillway and sluiceway modifications and turbine rehab decisions. The survival study program is tentatively extended four years, with final report in 2006, however is heavily dependent on the annual test results.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete 2001 Field Testing	Jul, 2001
Complete 2001 Draft Final FPE Analysis	Mar, 2002
Complete Report	May, 2002
Complete 2002 Field Testing	Jul, 2002
Complete Reports	May, 2003
Complete 2003 Field Testing	Jul, 2003
Complete Reports	May, 2004
Complete 2004 Field Testing	Jul, 2004
Complete Reports	May, 2005
Complete 2005 Field Testing	Jul 2005
Complete Report	May, 2006

3. Cost Estimate ($millions)

Activity	FY02	FY03	FY04	FY05	FY06
Survival Analysis & Report	2.5	2.5	2.5	2.5	0.3

4. Issues

Reduced spill rates at The Dalles apparently results in increased numbers of juveniles which utilize the turbine and sluiceway passage routes, thus increasing the importance of fully understanding and resolving survival concerns via those routes.

Spillway deflectors are being investigated under a separate program intended to result in reducing gas levels at The Dalles. Due to relative shallow and turbulent stilling basin conditions at The Dalles, deflectors may also contribute to decreased direct juvenile mortality, however may also result in higher numbers of juveniles being swept into the Bridge Islands, located immediately downstream of the spillway. Deflectors and could also jeopardize potential benefits of the sluiceway outfall relocation measure.

5. RPA Action # 68, 82, 83, 86

33. Lower Monumental Gas Fast-Track (Deflectors)

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - The purpose of the additional deflectors and/or modifications is to allow higher spill levels for passing juvenile salmonids while staying below the 120% total dissolved gas (TDG) supersaturation level as recorded by existing tailrace fixed monitoring stations. Additionally, physical hydraulic model studies of the tailrace hydraulic conditions at Lower Monumental will be conducted to allow development of spill patterns to achieve acceptable tailrace hydraulic conditions for both adult fish passage and juvenile fish egress from the tailrace area. Deflector improvements will provide benefits in reduced TDG during involuntary spill events. A powerhouse/spillway divider wall will provide reductions in TDG loading to downstream water bodies during spillway operations. Physical modeling may also identify a better outfall location for the juvenile bypass system.

- **Description** - Deflectors have been constructed on six of the eight spillway bays at Lower Monumental. These deflectors are 12.5 feet long; one of which has a 15-foot radius transition. Possible modifications include the addition of deflectors to spillway bays 1 and 8, adding a radius transition to those deflectors in bays 3 to 7 and extending the downstream pier noses. Consideration may also be given to relocating the deflectors at an elevation optimized for current operation. A spillway/powerhouse divider wall will also be examined in the models and addressed in the Design Documentation Report. Engineering work began on this project in FY99. Construction of a physical hydraulic model (spillway sectional) was completed in FY99. Activities for FY00 included: a) hydraulic model testing of the Lower Monumental spillway sectional model; b) construction of the Lower Monumental General model, and; c) initial testing on the general model. Deflector performance curves for existing deflectors were developed utilizing the sectional model. These curves were examined utilizing current operations to determine if existing deflectors should be modified to improve Total Dissolved Gas (TDG) performance. Additional features such as end bay deflectors; radius transitions and extended piers were also examined to assess possible performance improvements. Once construction and calibration was completed on the general model, testing commenced utilizing resulting modifications developed from the sectional model. In FY01, spill patterns will be evaluated to determine if changes should be made operationally once new end bay or modified deflectors are in place. Velocities will be documented throughout the tailrace region to identify locations for a potential new juvenile fish outfall site. Testing of the general model will be completed in FY01.

2. Major Activities/Tasks – Preparation of a Design Documentation Report will begin in FY02. The DDR will include information such as gas performance of the existing structure, proposed and recommended modifications, anticipated TDG performance improvement, estimated construction costs and schedule. Following completion of the DDR, contract documents and NEPA documentation will be prepared by June 2003 followed by a construction contract to complete the installation of deflectors by March 2004. If major mitigative structures such as navigation cells or powerhouse spillway divider wall are recommended, then these would be covered under separate contracts.

Milestone	Date (Mo/Yr)
General Model Testing complete	September 2001
Design Documentation Report - complete	September 2002
Plans and Specifications complete	June 2003
NEPA documentation complete	June 2003

Advertise and Award	September 2003
Construction Complete	March 2004

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$415k	$2355k	$4570k	0	0

4. Issues

a) Construction is dependent on recommendations from the Design Documentation report.

b) The physical hydraulic models are also being used to evaluate a dam safety issue related to erosion in the existing spillway stilling basin. The erosion testing may be a priority consideration and may delay completion of model testing for deflector design criteria.

c) The cost estimates presented in the table above assume addition of end bay deflectors only. If modified deflectors are recommended in the DDR, then construction costs will be higher. Costs do not reflect funds which may be needed to implement a change in location of the Juvenile bypass outfall site.

d) Navigation issues may develop with additional deflectors at Lower Monumental similar to that which occurred with Ice Harbor. Mitigation actions/studies, if needed, may increase schedules and costs.

5. RPA Action

- RPA Action 134 – "The Corps shall continue the spillway deflector optimization program at each FCRPS project and implement it, as warranted. The Corps and BPA shall conduct physical and biological evaluations to ensure optimum gas abatement and fish passage conditions. Implementation decisions will be based on the effect of spill duration and volume on TDG, spillway effectiveness, spill efficiency, forebay residence time, and total project and system survival of juvenile salmon and steelhead passing FCRPS dams."

- RPA Action 135 – "The Corps shall include evaluations of divider walls at each FCRPS project in the spillway deflector optimization program. Design development and construction of the divider walls would begin only after coordination within the annual planning process, and only if warranted."

- RPA Action 76: "The Corps shall investigate, design, and construct, as warranted, a new juvenile bypass outfall at Lower Monumental Dam. Investigations shall be conducted in conjunction with spillway deflector and spill patter optimization studies."

34. Little Goose Gas Fast-Track (Deflectors)

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - The purpose of the additional deflectors and/or modifications is to allow higher spill levels for passing juvenile salmonids while staying below the 120% total dissolved gas (TDG) supersaturation level as recorded by existing tailrace fixed monitoring stations. Additionally, physical hydraulic model studies of the tailrace hydraulic conditions at Little Goose will be conducted to allow development of spill patterns to achieve acceptable tailrace hydraulic conditions for both adult fish passage and juvenile fish egress from the tailrace area. Deflector improvements will provide benefits in reduced TDG during involuntary spill events. A powerhouse/spillway divider wall will provide reductions in TDG loading to downstream water bodies during spillway operations.

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- **Description -** Deflectors have been constructed on six of the eight spillway bays at Little Goose. These deflectors are only 8 feet long and do not have a radiused transition. Possible modifications include the addition of deflectors in end bays 1 and 8, adding radius transitions and pier nose extensions to the existing deflectors and possibly extending the deflector length to 12.5 feet. Consideration may also be given to relocating the deflectors at an elevation optimized for current operation. A spillway/powerhouse divider wall will also be examined in the models and addressed in the Design Documentation Report.

2. Major Activities/Tasks - Work was be initiated on this project in FY00. In FY01, testing of the sectional model will be completed along with construction of a general physical hydraulic model of Little Goose dam. Testing of the general model will begin in FY01 and be completed in FY02. Once testing is complete on these models, a Design Documentation Report (DDR) will be prepared which will document all structural changes needed for implementation of additional/modified deflectors at Little Goose. The DDR will also address spill pattern changes and any mitigating structural changes which may be needed to accommodate operation of additional/modified deflectors. The DDR will be completed by the end of FY03. Plans and specifications or contract documents and any required NEPA documents will be completed by June 2004 and advertisement for a contractor will begin. Construction will be completed by March FY05.

Milestone(10pt)	**Date (Mo/Yr)** (10pt)
General Model Testing complete	September 2002
Design Documentation Report - complete	September 2003
Plans and Specifications complete	June 2004
NEPA documentation complete	June 2004
Advertise and Award	September 2004
Construction Complete	March 2005

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
720	**575**	**2445**	**4600**	**0**

4. Issues (10pt) – Construction is dependent on recommendations from the Design Documentation report. Assuming that the DDR recommends construction and if resources (people and money) become available, it may be possible to accelerate this project to allow construction completion in FY04. Estimated construction costs shown in the above table assume that end bay deflectors are added. If modified deflectors and/or if implementation of a divider wall is recommended, then construction costs will be higher.

5. RPA Action –

RPA Action 134 – "The Corps shall continue the spillway deflector optimization program at each FCRPS project and implement it, as warranted. The Corps and BPA shall conduct physical and biological evaluations to ensure optimum gas abatement and fish passage conditions. Implementation decisions will be based on the effect of spill duration and volume on TDG, spillway effectiveness, spill efficiency, forebay residence time, and total project and system survival of juvenile salmon and steelhead passing FCRPS dams."

RPA Action 135 – "The Corps shall include evaluations of divider walls at each FCRPS project in the spillway deflector optimization program. Design development and construction of the divider walls would begin only after coordination within the annual planning process, and only if warranted."

35. McNary Gas Fast-Track (Deflectors)

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - The purpose of the additional deflectors and/or modifications is to allow higher spill levels for passing juvenile salmonids while staying below the 120% total dissolved gas (TDG) supersaturation level as recorded by existing tailrace fixed monitoring stations. Additionally, physical hydraulic model studies of the tailrace hydraulic conditions at McNary will be conducted to allow development of spill patterns to achieve acceptable tailrace hydraulic conditions for both adult fish passage and juvenile fish egress from the tailrace area. Deflector improvements will provide benefits in reduced TDG during involuntary spill events. A powerhouse/spillway divider wall will provide reductions in TDG loading to downstream water bodies during spillway operations.

- **Description -** The McNary spillway consists of 22 spillway bays. Twenty-one spill bays are operational. Eighteen spillway bays have deflectors. These deflectors are 12.5 feet long but do not have the radius transition. Possible modifications include adding gate hoists to some spill bays and adding deflectors to spillway bays 1, 2, 21 and 22. Other modifications may include fitting the existing deflectors with a radius transition and extending the downstream piers. Consideration may also be given to relocating the deflectors at an elevation optimized for current operation.

2. Major Activities/Tasks – Engineering work began on this project in FY99. Construction and testing of a physical hydraulic spillway sectional model was completed in FY00. Construction and testing of a physical hydraulic general model of McNary dam is anticipated for completion in FY01. New spill patterns will be developed utilizing the general model – one pattern will be developed for the spring 2001 outmigration and one pattern for the spring 2002 outmigration with deflectors installed on all bays. The effect of a powerhouse/spillway divider wall will also be investigated. Concurrent with the testing on the general model, contract documents have been initiated in FY01 for two contracts: one for construction of 4 end-bay deflectors, and; one for supply of four gate hoists needed to operate specific spillbays at McNary dam during the spill for fish operations. In FY02, construction of the 4 endbay deflectors and gate hoists supply and installation will occur. In addition the Design Documentation Report will be completed. Pending recommendations in the DDR, a phase II construction may be needed to correct any identified problems with tailrace hydraulic conditions. A post construction evaluation will be conducted either in FY02 or FY03 depending on whether or phase 2 construction is needed.

Milestone	Date (Mo/Yr)
Complete DDR	Dec/01
Complete Phase I - Construction endbay deflectors	Mar/02
Complete installation of gate hoists	Mar/02
Complete Preparation of P&S Phase II	Jun/02
Complete Phase II construction (tentative)	Mar/03
Complete Post Construction Evaluation	Dec/03

3. **Cost Estimate**

FY02	FY03	FY04	FY05	FY06
$3,015,000	**$4,800,000**	**$100,000**		

4. **Issues -** Phase 2 construction is dependent on results and recommendations from the Design Documentation Report (DDR). If no additional construction is necessary, then the post construction evaluation can occur in FY02 otherwise, it will occur in FY03 following completion of the Phase 2 construction. Costs will change according to the DDR recommendations.

5. **RPA Action**

- RPA Action 134 –The Corps shall continue the spillway deflector optimization program at each FCRPS project and implement it, as warranted. The Corps and BPA shall conduct physical and biological evaluations to ensure optimum gas abatement and fish passage conditions. Implementation decisions will be based on the effect of spill duration and volume on TDG, spillway effectiveness, spill efficiency, forebay residence time, and total project and system survival of juvenile salmon and steelhead passing FCRPS dams.

- RPA Action 135 – The Corps shall include evaluations of divider walls at each FCRPS project in the spillway deflector optimization program. Design development and construction of the divider walls would begin only after coordination within the annual planning process, and only if warranted.

36. John Day Extended-Length Screens

Multi-Year Plan

1. Project Information

- **Purpose/Objective -** The existing 20-foot submerged traveling screens at John Day Dam will be replaced by 40-foot extended length submerged bar screens (ESBS's). The longer screen length will intercept a greater percentage of fish, increasing fish guidance efficiency. Existing vertical barrier screens (VBS) located in the bulkhead slot of each turbine unit, need to be modified due to the ESBS's diverting a greater volume of water into the slots.

  Prototype screens were tested in FY 97 and performed successfully biologically. Since 1997 biological and structural problems with the screens have been discovered, requiring additional analysis and testing of alternative designs.

- Structural/mechanical testing will continue when a biologically acceptable design has been installed and can be left in place for at least one year.

- **Description –** The ESBS and VBS in unit 7 will be modified and biological, structural and mechanical testing will begin in April 2002. It is anticipated that the final results of the biological testing will be available by January 2003. Structural and mechanical testing will continue until the structural integrity has been verified.

2. Major Activities/Tasks –

- Construct and install new VBS in unit seven.
- Complete model and prototype studies to obtain and compare velocity profiles on the face of the ESBS.
- Design gatewell modifications to be prototype tested (if necessary).
- Complete structural testing of the ESBS in unit seven; need a year of run-time on the ESBS.
- Complete plans and specifications for the final contract to supply VBS and ESBS. Contract will only be awarded if acceptable biological and structural/mechanical results are obtained during testing at unit seven and it is decided, by January 2003, that screen implementation will result in more benefits than surface bypass at either the spillway or powerhouse.

Milestone	Date (Mo/Yr)
Install modified VBS and initiate testing	April 2002
Complete P&S for installation of ESBS, VBS and cutting of deck slots	April 2003
Award Contract for installation of ESBS, VBS and cutting of deck slots	Aug 2003
Initiate P&S for installation of shear boom	Oct 2001
Complete P&S for installation of shear boom	May 2002
Award Contract for installation of shear boom	August 2002
Complete installation of shear boom	March 2003
Complete installation of ESBS and VBS	March 2007
Initiate Post Construction Evaluation	April 2007
Complete Post Construction Evaluation and reports	December 2008

3. Cost Estimate -

Activity	FY02	FY03	FY04	FY05	FY06
	5090,000	**12440,000**	**22000,000**	**17280,000**	**8250,000**

4. **Issues –**
    - Performance of new VBS/ESBS needs to be verified through biological, structural and mechanical testing.
    - Only one year of biological data on one unit (unit 7) will be available by January 2003. This date has been established by the BiOp as the time when the relative passage survival benefits of replacing existing standard-length intake screens with extended-length screens needs to be compared with the survival at one or more skeleton or spillway bays. Further, no information will be available regarding orifice modifications prior to the decision date of January 2003. Therefore is seems unlikely that orifice work will be necessary because a decision between screens and a surface bypass method will likely be made before an analysis of orifice modifications can be completed.
        - The schedule and cost estimates provided are based on the assumption that no analysis or modification of the orifices will be necessary. If prototype testing indicates that orifice modifications need further consideration this work plan will need to be modified.
        - Out-year funding for extended-length screens has been included in this multi-year plan as a placeholder. These funds may be used for surface bypass implementation rather than screens if the decision is made to proceed with installation of a surface bypass device in lieu of screens.

5. **RPA Action –**
    - 73; Continue prototype development and investigations of extended submerged intake screens, gatewell vertical barrier screens, and, if necessary orifices to optimize guidance and safe passage through the system including a gatewell debris cleaning plan.
    - 98; By January 2003, develop an analysis that compares the relative passage survival benefits of replacing existing standard-length intake screens with extended-length screens at the powerhouse to surface collection at one or more skeleton or spillway bays.
    - 146; the Corps shall address debris-handling needs and continue to assess more efficient and effective debris-handling techniques to ensure that the performance of both new and old fish passage facilities will not be compromised.

37. McNary Outfall Evaluation [*Under Development*]

38. The Dalles Sluice Outfall & Auxiliary Adult Water Supply

DRAFT Multi-Year Plan
8 March, 2001

1. Project Information

- **Purpose/Objective:** The purpose of this measure is twofold:
  1) To provide an emergency water supply for adult fish attraction along the powerhouse and south end of the spillway should one of the two existing fish water turbine units fail.
  2) To relocate the ice and trash sluiceway outfall to a location less prone to juvenile predation.

- **Description**

The existing fish units are both required to run simultaneously to provide approximately 4200 cfs adult attraction water, required for the Oregon side fish ladders.

An adult attraction backup water supply alternative analysis was completed in 1997, with installation of a pump system recommended, at an estimated total cost of approximately $33 million. A separate study to evaluate the feasibility to relocate the ice and trash sluiceway outfall to a location less prone to juvenile predation was also completed in 1997, under The Dalles Surface Bypass Study. A subsequent third study concluded significant savings could be realized if the two measures were combined for economy, utilizing a dewatering system in a relocated sluiceway channel to provide the backup adult water supply.

Development of a Detailed Design Report (DDR), including a more detailed design and cost estimate for the combined system, is scheduled for completion by May, 2001; however, the outfall site previously selected for detailed development in the DDR has recently been determined unsatisfactory based on extensive hydraulic model studies. Initiation of Plans and Specs for construction of the project will be delayed, pending completion of a reanalysis of potential outfall locations and completion of the DDR. Consideration will now also be given to the impact on the outfall site of possible future installation of spillway flow deflectors.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete Alternate Sluice Outfall Site Reanalysis	Oct , 2001
Complete Detailed Design Report	Sep, 2002
Complete P&S for Outfall Relocation	Feb, 2004
Start Construction Outfall Relocation	Jul, 2004
Complete Construction Outfall Relocation	Apr, 2006

3. Cost Estimate ($millions)

Activity	FY02	FY03	FY04	FY05	FY06
Studies & Design	2.5	3.0	0.4	0.3	0.2
Biological Testing					2.0
Construction			5.0	15.0	10.0
Other	0.1	0.1	0.5	1.2	0.8
Contingency				3.0	2.0
TOTAL	2.6	3.1	5.9	19.5	15.0

4. Issues Several factors will need to be taken into consideration to determine the relative merits of this measure, including the impact on a selected outfall relocation site of possible spillway deflectors, spill pattern future spill volume, anticipated sluiceway juvenile passage efficiency, anticipated predation control success in the tailrace, and cost. The above construction cost is based on the current design developed in the DDR.

. **5. RPA Action: 70, 122**

39. The Dalles Adult Entrance Channel Dewatering Mods

DRAFT Multi-Year Plan
8 March, 2001

1. Project Information

- **Purpose/Objective**

The purpose of this item is to provide a dewatering system for the lower portions of the fishladder entrances and transportation conduit at the south shore fish ladders at The Dalles dam to allow inspection and maintenance to be performed under dewatered conditions. Previous attempts to dewater the system were unsuccessful, primarily due to high leakage through numerous stoplogs that were intended to seal the system. Discovery of damaged underwater screens within the adult entrance conduit at The Dalles reinforced the need for improvements which would allow safe inspection and maintenance of the adult passage system.

- **Description**

Plans and specifications are currently being developed. The stoplogs would be re-sealed with an improved seal design and additional pumping capacity provided for dewatering the adult transportation system.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Complete P&S for Adult Channel Dewatering Mods	Aug, 2001
Start construction contract	Dec, 2001
Complete construction	Mar, 2004

3. Cost Estimate ($millions)

Activity	FY02	FY03	FY04	FY05	FY06
Design	0.1	0.1	0.1		
Construction Contract	1.0	1.8	1.7		
Other	0.5	0.2	0.2		
Contingency	0.3	0.6	0.6		
TOTAL	1.9	2.7	2.6		

4. Issues Construction is assumed to require two in-water work periods, however if removal and repair of the downstream stoplogs can be performed continuously, the construction time could likely be significantly reduced.

5. RPA Action: 123

40. McNary/Ice Harbor Adult Fallback

Multi-Year Plan

1. Project Information

- **Purpose/Objective –** At McNary and Ice Harbor Dams, a juvenile fish bypass facility (bypass) guide downstream migrant salmon and steelhead around the powerhouse turbines and to the tailrace. Downstream migrant juveniles are diverted by intake screens into the turbine gate slots. The juveniles exit the gate slot through gate slot orifices that discharge into the collection channel that traverses the length of the powerhouse. The fish are then directed into a bypass pipe that delivers them to the tailrace or into a sample/holding juvenile fish facility. Periodically, adult salmon and steelhead "fallback" from the dam forebay and end up passing through this juvenile collection system. Thousands of adults (between 4,724 and 11,155 annually over the last 11 years) are collected in the McNary juvenile fish facility separator each year, for example, and are returned to the tailrace through a 14-inch outfall pipe. Some of these adults have been observed holding in the upper end of the juvenile collection channel with others attempting to pass upstream by jumping at the gate slot orifice discharge flow. One concern based on observation is that some of the fish attempting to migrate by jumping at the gate slot orifice flow end up getting injured from impact or stranded on personnel access walkways. There is also a concern that the migration of these adult fish is being delayed and they may exhaust their energies to the point where they cannot reach their destined spawning grounds or survive to spawn. Currently there is very little data available to quantify the delay and/or injury to those adults holding in the collection channel. Research and associated development of systems to manage the problem of adult fallbacks into the juvenile collection channels is warranted in terms of a biological risk reduction to migrating adult salmon and steelhead.

- **Description –** There are a series of activities required to fully evaluate the adult fallback problem and subsequently implement methods to reduce injury and minimize delay of adult fish that fall back into the juvenile fish collection channels. The first task is to fully understand the extent of the adult fallback problem in terms of both injury and migration delay. Currently, there is very little data available to quantify the delay and or injury to those fish holding in the collection channel. Presently, research is underway to better determine the degree of delay and injury suffered by these fallbacks. Future research may be necessary to complete the evaluation. A better understanding of the problem allows a more effective method of evaluating success of the current system used to handle the adult fallbacks and the development of new methods. The current system being used is the handling of the adult fallbacks at the juvenile fish separator and manually placing them in the adult bypass outfall pipe. New methods of providing egress to adult fallbacks in the collection channels are presently being studied. The project team identified five potential concepts of egress and screened them down to three to be studied in greater detail. The remaining concepts include avoidance behavioral crowding of the fish using strobe lights and an Alaska Steep-Pass Ladder to be located at the upstream end of the collection channel with a choice of outfall locations. The two possible outfall locations for the Alaska Steep-Pass Ladder concept is the forebay and the tailrace. The preferred solution has not been determined yet but it appears as though the Alaska Steep-Pass Ladder may prove to be the preferred approach.

  After the research and study are complete a plan will be implemented to biologically test the single chosen alternative. Assuming the Alaska Steep-Pass Ladder is the selected method a temporary ladder will be installed in the North (upstream) end of the juvenile collection channel at McNary. The ladder will be provided with a temporary water supply and a method to return those adults who use the ladder back to the river. The ladder would exit to a holding tank during the testing period. If it proves effective in attracting the adults in the collection channel the outlet works would then be installed followed by the installation of complete systems at all affected projects.

2. **Major Activities/Tasks –** To complete the investigation into ways to provide egress for adult fish that have fallen back into the juvenile fish collection channel and to install the preferred remedies, the following tasks need to be accomplished:

   - Determine the degree of delay and injury suffered by these adult fallbacks.
   - Determine best possible and feasible system to provide egress to adult fallbacks in the collection channel.
   - Perform biological testing at McNary on the preferred method of adult egress from the collection channel to determine effectiveness of solution prior to implementing fully operational systems.
   - Install the tested and proven system that provides adult fallback egress from the juvenile fish collection channel at McNary.
   - Install the tested and proven system that provides adult fallback egress from the juvenile fish collection channel at Ice Harbor.

Milestone	Date
Complete the study analyzing methods of providing adult fallback egress from juvenile collection channels and select the preferred remedy.	Aug 2001
Complete the research being done to determine the degree of delay and injury suffered by these adult fallbacks.	Feb 2002
Complete plans and specs for partial prototype system to be installed at McNary for biological testing of the selected method of adult fallback egress from the juvenile collection channel.	Aug 2002
Install partial prototype of the system at McNary Dam.	Jan 2003
Conduct biological testing of the prototype system installed at McNary to verify effectiveness. Complete testing and verify results.	Jan 2005
Complete plans and specifications to complete installation of system at McNary utilizing the test apparatus as much as possible.	Jul 2005
Install remainder of system at McNary.	Jan 2006
Complete plans and specifications of system at Ice Harbor.	Jul 2005
Install system at Ice Harbor.	Jan 2006

3. **Cost Estimate**

FY02	FY03	FY04	FY05	FY06
$750k	**$650k**	**$350k**	**$350k**	**$1,250k**

4. **Issues** – Work to be performed beyond the initial research of the problem of adult fallbacks into the juvenile collection channel is pending the results of this primary research. Schedules and costs shown assume that further work and system testing and installation is defensible. Testing runs through FY03, FY04, and into FY05.

5. **RPA Action –** This project addresses issues contained in RPA Action Number 112 of Chapter 9 of the FCRPS Biological Opinion. Specifically, investigating ways to provide egress for adult fallbacks in the juvenile collection channels at McNary and Ice Harbor dams and to implement required system changes as deemed appropriate.

41. Bonneville Adult Fallback

Multi-Year Plan

1. Project Information

- **Purpose/Objective:** The goal of the program is to determine the cause of adult fallback over the spillway at Bonneville Dam by adult fish exiting the Bradford Island ladder and to design, install and evaluate a corrective action that will reduce or eliminate the problem.

- **Description:** The present plan calls for the development of alternative ladder modifications and continued telemetry studies of released adults. In 1999 and 2000, analyses of radio telemetry and forebay hydrualic model data did not reveal a correlation between hydraulic conditions and fallback rates, suggesting that the cause for fallback from fish exiting the Bradford Island fishway is due to shoreline orientation of adult salmonid migrants. However, analyses of fallback rates and environmental variables did show that fallback rates increase as total river flow and spillway discharge increase. Continued study, especially after the addition of flow deflectors on the remaining spillway bays is anticipated so that a wider range of spill conditions can be analyzed.

2. Major Activities/Tasks: In 2002, work will include continued telemetry on released fish. Eventually modifications to existing fishways (fish ladders) or a completely new fish ladder on the Oregon side may be designed, installed and evaluated.

Milestone	Date (Mo/Yr)
Complete Fishway Alternatives Study	Dec/01
Present Results of 2001 Fish Releases and Study	Nov/01
Present Results of 2002 Fish Releases and Study	Nov/02
Present Results of 2003 Fish Releases and Study	Nov/03
Present Results of 2004 Fish Releases and Study (Deflectors Installed)	Nov/04
Present Results of 2005 Fish Releases and Study (Deflectors Installed)	Nov/05
Complete Design of New or Modified Ladder	Sep/06
Complete Construction of New or Modified Ladder	Feb/08
Presentation of Biological Evaluation Results	Nov/09

3. Cost Estimate:

Activity	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09
Telemetry Study	500	500	500	500	50			
Design New/Modified Ladder					500			
Construct New/Modified Ladder								
Plans and Specs						500		
Construction						2000	8000	
Biological Evaluation							500	500
TOTALS	**500**	**500**	**500**	**500**	**550**	**2500**	**8500**	**500**

4. Issues: The above plan assumes that a new or modified ladder will be needed to eliminate the problem and that it will have regional support to proceed.

5. **RPA Action:** Biological Opinion measure No. 113. "The Corps shall investigate measures to reduce adult steelhead and salmon fallback and mortality through the Bonneville Dam spillway. A final report shall be submitted to NMFS stating the findings of these investigations and recommending corrective measures. Potential remedies shall be included in the annual planning process."

42. Bonneville 2 AWS

Multi-Year Plan

1. Project Information

- **Purpose/Objective:** The purpose of the program is to provide the Bonneville Second Powerhouse with a backup auxiliary water supply. The current backup system, the ice/trash chute draws adult fish into the AWS system where they are trapped for extended periods of time. The project is also to provide evaluate and solve debris buildup problems in front of the two fish turbines intakes.

- **Description:** In 2000, an alternatives study determined that with the closing of the orifice openings along the collection channel and the selective closing of some diffuser and entrance gates, the collection channel flows could stay within criteria even with only one turbine operating. Also, a recon study determined the debris problem in front of the turbines was flood related. In 2001, a design document is underway to design the gates to close the downstream orifice openings, develop an operational manual for closing additional gates and diffusers under different tailwater conditions and look at improving the trashrack and trashrake system used at the turbine intakes.

2. Major Activities/Tasks: In 2001, the design documentation report will be completed. In 2002 preparation of plans and spec can begin with installation and evaluation of the repair to follow.

Milestone	Date (Mo/Yr)
Complete Design Documentation Report	Sep/01
Complete Plans and Specs	Jun/02
Complete Installation	Feb/03
Complete Evaluation of Repair	Nov/03

3. **Cost Estimate:**

Activity	FY02	FY03	FY04	FY05	FY06
Complete Design Document	50				
Complete Installation					
Plans and Specs	150				
Construction	200	500			
Biological Evaluation		100	50		
TOTALS	**400**	**600**	**50**		

4. **Issues:** This work plan assumes that the region will agree to block the existing orifice openings along the collection channel in lieu of building motorized gates. The decision to install motorized gates for each of the orifice openings would add an additional $1,500,000 to the contract costs.

5. **RPA Action:** Biological Opinion measure Nos. 125 and 127. "The Corps will develop and implement an automated monitoring and alarm system at all FCRPS projects to monitor changes in head differential remotely between the primary auxiliary water supply conduits/channels and the adult collection channels to minimize diffuser damage due to excessive differentials." "The Corps shall continue to investigation of the Bonneville Second Powerhouse adult fishway auxiliary water supply system and shall identify measures to satisfactorily address emergency backup auxiliary water needs."

43. John Day North Shore AWS

Multi-Year Plan

1. Project Information

- **Purpose/Objective:** The purpose of the program is to bring the John Day North Shore Fish Ladder into criteria for flow. Attention has focused on the six turbine pumps that were designed to furnish auxiliary water for the diffusers and transportation channel in the lower part of the ladder.

- **Description:** Many operational complaints have been leveled at the ability of the pumps to meet present day fisheries criteria. New circuit breakers have been installed removing that item from the set of possible remedies. At least one motor has been damaged. Pin pointing whether these pumps have hydraulic problems or electrical problems would allow the selection of a remedy that would go directly to the core of the problem

2. **Major Activities/Tasks:** In 2001, a letter report will be completed that will summarize the historical record including past attempts to correct the problem. In 2002 a design documentation report will be initiated and corrective action recommended. The selected design shall be installed and evaluated.

Milestone	Date (Mo/Yr)
Complete Letter Report	Sep/01
Complete Design Documentation Report	Sep/02
Complete Installation of Selected Design	Feb/04
Present Results of Corrective Action	Nov/04

3. **Cost Estimate:**

Activity	FY02	FY03	FY04	FY05	FY06
Complete Design Report	250				
Complete Repairs					
Plans and Specs		250	50		
Construction			1000		
Biological Evaluation			100	50	
TOTALS	**250**	**250**	**1150**	**50**	

4. **Issues:** The above plan assumes a large construction cost in 2004. This is a placeholder since it is uncertain what the recommended corrective measure will be.

5. **RPA Action:** Biological Opinion measure No. 128. "The Corps shall initiate an engineering study to evaluate existing limitations relating to its inability to satisfy fish passage plan operating criteria at the John Day Dam north shore ladder."

44. John Day Salmonid Holding and Jumping
South Ladder and Transition Pool

Multi-Year Plan

1. Project Information

- **Purpose/Objective:** The goal of the program is to determine the cause of holding and jumping behavior in adult steelhead at the John Day south fish ladder and holding behavior in the John Day Transition Pool and develop, design, install and evaluate corrective measures if warranted.

- **Description:** A significant number of adult steelhead migrating through the fish ladders at John Day Dam exhibit a behavior that is not common in other fish ladders at federal dams on the main stem Columbia and Snake rivers. These fish jump into the air during ascent through the ladder. Many strike parts of the ladder's concrete structures as they fall back into the ladder. Others fall onto the walkway or other areas outside of the ladder where they die unless quickly placed back into water. This behavior is believed to be a response of the fish to the environment within the ladder. The factor or factors within the many elements that comprise the fish ladder environment that provide the stimuli for this behavior are not known. Many fish also hold in the ladder for long periods.

2. Major Activities/Tasks: The present plan calls for the design and modeling of new weir slots for the entire fish ladder. (A prototype slot cut in one of the weirs and monitored during the 2000 fall return decreased jumping by 50%.) Once the new slot design is selected, a prototype section of the ladder (7 pools) would then be tested and, if successful, the entire ladder would then be reconfigured. Radio telemetry data will be used to assess the magnitude and timing of delay in the ladder. Modifications to the ladder will be assessed in terms of passage time as well as a reduction in visible jumping and holding behavior.

Milestone	Date (Mo/Yr)
Complete Modeling and Design of New Weirs Slots	Jul/01
Complete Prototype Installation (incl. transition pool)	Feb/02
Present Prototype Results	Nov/02
Complete Production Installation	Feb/03
Present Final Production Results	Nov/03
Presentation of Full District Implementation Results	Nov/03

3. Cost Estimate:

Activity	FY02	FY03	FY04	FY05	FY06
Install Prototype (7 pools)	100				
Evaluate Prototype	25	50			
Install Full Ladder Section	50	300			
Evaluate Final Results		25	50		
TOTALS	**175**	**375**	**50**		

4. Issues: The above plan assumes that funds for modeling in FY01 will be obtained and the action completed by summer of 2001.

5. **RPA Action:** Biological Opinion measure No. 110. "The Corps shall use information from previous and ongoing investigations regarding the problem of adult steelhead and fall chinook salmon holding and jumping in the fish ladders at John Day, develop a proposed course of action, and implement it, as warranted." Also, Biological Opinion measure No. 116. "The Corps shall investigate adult fish delay and fallback at junction ladder pools and implement remedies to reduce this problem, as warranted."

45. John Day Ladder Temperature

Multi-Year Plan

1. Project Information

- **Purpose/Objective:** The purpose of the program is to determine the effects on fish passage, if any, due to variations in water temperatures at various sections of the John Day Fishways. If shown to have an effect, corrective measures would be design and implemented.

- **Description:** Data shows that water temperatures at various sections of the John Day fishways differ in temperature by as much as 5 degrees Fahrenheit at times. Effects of such differences on fish passage are unknown.

2. **Major Activities/Tasks:** In 2001, a letter report will be completed that will attempt to summarize the historical record and determine if further investigation is warranted. If so, in 2002 a design documentation report will be initiated and corrective action(s) recommended. The selected design shall be installed and evaluated.

Milestone	Date (Mo/Yr)
Complete Letter Report	Sep/01
Complete Design Documentation Report	Sep/03
Complete Installation of Selected Design	Feb/05
Present Results of Corrective Action	Nov/05

3. **Cost Estimate:**

Activity	FY02	FY03	FY04	FY05	FY06
Complete Design Report	300	400			
Complete Repairs					
Plans and Specs			250	50	
Construction				2000	
Biological Evaluation				250	250
TOTALS	**300**	**400**	**250**	**2300**	**250**

4. **Issues:** The above plan assumes a large construction cost in 2005. This is a placeholder since it is uncertain what the recommended corrective measure will be.

5. **RPA Action:** Biological Opinion measure No. 114. "The Corps shall examine existing fish ladder water temperature data and adult radio tracking telemetry to determine whether observed temperature differences in fishways adversely affect fish passage time and holding behavior. If non-uniform temperatures are found to cause delay, means for supplying cooler water to identified areas of warmer temperatures should be developed and implemented in coordination with the annual planning process."

46. Lower Granite Adult Fishway Auxiliary Water Supply

Multi-Year Plan

1. Project Information

- **Purpose/Objective** – Adult fishway auxiliary water supply systems provide fish attraction water flows to help migrating adult salmonids to find fish ladder entrances and to proceed up the fishways with minimum delay. The bypass of adult anadromous fish upriver for spawning is a critical portion of their life cycle. Hydraulic criteria have been established to facilitate the efficiency of their bypassing the dams by using upstream migrant systems. Compliance, where practicable, to these criteria is essential to operating the systems optimally. The adult fishway auxiliary water supply system at Lower Granite currently has one pump spare capacity as required with the actions set forth in the Biological Opinion (Bi-Op). The general criteria established by the Bi-Op requires: (1) that auxiliary water system provide an emergency spare capacity equivalent to one pump above the maximum normal auxiliary flows, and (2) that electrical reliability should provide for 100% back-up in the event of an outage due to a single failure of either the bus, switchgear, or transformers feeding the turbine pump appurtenances. The objective for providing spare water supply capacity increases overall system reliability by providing emergency water supply for use during partial failures. It also increases the opportunity for practicing preventative maintenance on idle equipment without requiring system operation outside of the criteria established in the fish passage plan. In addition actual operating time on equipment will be reduced, increasing the overall useful operating life. By configuring the adult fishway system with spare water capacity and improved electrical reliability, fish passage plan criteria can be maintained, thus ensuring that the passage of adult salmonids through the system will be at the highest percentage with minimal delay.

- **Description -** The 2000 Bi-Op (RPA actions 120, 121 and 129) requires development of improved adult fishway entrance conditions by conducting hydraulic analysis of the systems, developing maintenance records and procedures, and implementation of corrective measures as warranted. Phase I and Phase II Technical Reports were led by the COE to review several alternatives to determine the most cost effective and reliably sound method to achieve the actions required by the Bi-Op. Since the dam was constructed, the existing auxiliary water supply system has proven to be very reliable. The existing auxiliary water supply system uses two of three electric motor-driven pumps with speed reducers to supply the auxiliary water to the lower fishway and the fish ladder lower diffusers. The recommended course of action is to replace the gear reducer (Philadelphia Gear) with a spare gear reducer (Falk) so that all of the gear reducers will be of the same make and construction. A new gear reducer will be provided and stored on site as a spare unit to service any one of the three units. Modifications to the electrical service to the pump motors will be necessary to provide redundancy of the power supply and the motor starter enclosures will be reconfigured to provide isolation between all of the starter units to eliminate the potential for a single-mode failure of all of the pumps due to an electrical fault in one of the enclosures as now configured.

  A detailed hydraulic model will be developed for the Lower Granite Adult Fishway system as recommended in the Bi-Op and utilized to confirm or suggest modifications to existing operational practices.

2. Major Activities/Tasks - At Lower Granite it is recommended to install the spare Falk gear reducer on Pump #1, and provide a new Falk gear reducer for the plant spare. The electrical service to the pumps will be reconfigured to provide redundancy between the two bus feeders, and the motor starter enclosures will be reconfigured to provide isolation between each of the units. The construction will take place in one year during the normal January-February ladder outage.

- The Lower Granite Adult Fishway System will be computer modeled to evaluate the upstream migrant systems as currently configured. Information will be collected to determine geometry and operational practice for fish ladder system. Model input files will be developed to simulate hydraulic conditions for current operation and a recommended operation. The model will be used to develop final recommendations on the best operation of the adult bypass systems and potential structural modifications to the system. The model will also be utilized to predict operational criteria as a result of implementation of the proposed alternative.

- The tasks will include: (a) collection of Project "as-built" drawings to define geometry and system controls for the fish ladder, (b) development of hydraulic model to simulate the system, (c) verification of the model using existing data for the current operation of the system, (d) report preparation which describes the system geometry and operation, the computer model, verification of model, and preliminary recommendation to improve fish ladder operation, and (e) perform field verification of the model at low tailwater elevations.

- The Construction activities will include demolition of an existing gear reducer, installation of a spare gear reducer, and procurement of a new gear reducer for onsite spare parts inventory.

- Electrical redundancy will be provided for pump feeder circuits by installing one automatic transfer switch (ATS), connected between Bus No. 1 and Bus No. 2, and feeding Pump No. 1. Pump No. 2 would be permanently connected Bus No. 2 and Pump No. 3 permanently connected to Bus No. 1. In the event of an electrical failure of one of the buses, the ATS will switch Pump No. 1 over to the energized bus, thus always providing operation to two AWS pumps. Each of the starter enclosures will be isolated, either through physical separation or addition of barriers between the starter enclosures.

MILESTONE	DATE (MO/YR)
Complete Computer Model	May 2001
Complete Plans and Specifications	Aug 2001
Phase I Construction, Electrical, ATS, Starter Modification	Nov 2001
Phase I Construction, Gear Reducer Demolition/Installation	Jan 2002
System Startup and Testing	Feb 2002
Complete Construction	Mar 2002

3. Cost Estimate

ACTIVITY	FY02	FY03	FY04	FY05	FY06
Design/EDC	$50,000				
Construction	$600,000				
Construction S&A	$60,000				
AFEP (placeholder)	$250,000	$250,000	$250,000	$250,000	$250,000
	$960,000	$250,000	$250,000	$250,000	$250,000

4. Issues – No significant construction issues. A majority of the work must be performed in January-February construction window during the annual outage, while some of the work can occur prior to the shutdown. Nature and magnitude of this work should be easily accomplished in this time frame.

5. RPA Action

RPA	CITATION
Action 120	The Corps shall develop improved operations for adult fishway main entrances at FCRPS dams so that the best possible attraction conditions are provided for adult migrants, both at the four Columbia River hydro projects and the four lower Snake hydro projects (where reservoir elevations are held near MOP). The Corps shall report the findings of fishway entrance flow-balancing investigations in a report to NMFS by the end of 2001 and shall continue to work through FPOM to evaluate and implement, as warranted, structural changes to satisfy fish passage plan fishway entrance criteria.
Action 121	The Corps shall develop and maintain an auxiliary water supply, emergency-parts inventory for all adult fishways where determined necessary, in coordination with NMFS.
Action 129	The Corps shall complete adult fishway auxiliary water supply evaluations at each lower Snake River hydro project and implement corrective measures as warranted.

47. Lower Monumental Adult Fishway Auxiliary Water Supply

Multi-Year Plan

1. Project Information

- **Purpose/Objective** – Adult fishway auxiliary water supply systems provide fish attraction water flows to help migrating adult salmonids to find fish ladder entrances and to proceed up the fishways with minimum delay. The bypass of adult anadromous fish upriver for spawning is a critical portion of their life cycle. Hydraulic criteria have been established to facilitate the efficiency of their bypassing the dams by using upstream migrant systems. Compliance, where practicable, to these criteria is essential to operating the systems optimally. In 1999, the Corps completed the Phase II Technical Report for the Emergency Auxiliary Water Supply (EAWS) system for the adult fish ladder at the Lower Monumental project. The report described the reliability of the existing system, identified and evaluated alternatives, and provided recommendations for implementation. At present, major modifications must be implemented at Lower Monumental to upgrade the fishways to operate within the established Fish Passage Plan (FPP) criteria. The general criteria established by the Bi-Op requires: (1) that auxiliary water system provide an emergency spare capacity equivalent to one pump above the maximum normal auxiliary flows, and (2) that electrical reliability should provide for 100% back-up in the event of an outage due to a single failure of either the bus, switchgear, or transformers feeding the turbine pump appurtenances. The objective for providing spare water supply capacity increases overall system reliability by providing emergency water supply for use during partial failures. It also increases the opportunity for practicing preventative maintenance on idle equipment without requiring system operation outside of the criteria established in the fish passage plan. In addition actual operating time on equipment will be reduced, increasing the overall useful operating life. By configuring the adult fishway system with spare water capacity and improved electrical reliability, fish passage plan criteria can be maintained, thus ensuring that the passage of adult salmonids through the system will be at the highest percentage with minimal delay.

- **Description -** The existing adult fishway system at Lower Monumental is comprised of separate fish ladders and collection systems on both the north and the south shores, supplied by a common conduit. The north shore fishway has a collection channel along the downstream face of the powerhouse, with floating orifices that provide additional points of access. The existing auxiliary water supply system uses three hydraulic turbine-driven pumps to provide auxiliary water. All three north shore pumps must operate full-time attempting to meet the FPP criteria. There has been some discussion that the system may run closer to criteria with only two pumps running instead of all three. There is no emergency auxiliary water supply available to sustain operation within criteria in the event of a pump failure and the existing pumps do not provide the intended design flow

  In FY 00, plans and specifications were initiated based in the recommendation in the Phase II Technical Report. A Value Engineering study was conducted in March of 2000 that identified a lower cost method to separate the existing auxiliary water supply system into distinct north and south shore systems by installation of an auxiliary pump in the tailrace near turbine unit 6. The intake was originally considered to be deep enough to eliminate potential injury to juvenile fish. The north shore entrances would continue to use two of the existing hydraulic turbine-driven pumps, with one in reserve. During development of P&S in FY 00, new concerns regarding the new pump intake location and fisheries criteria were raised at FFDRWG. The pump intake location was considered a potential risk to adult fish due to proximity to an adult fishway entrance. At the same time, alternatives being investigated at Little Goose raised enough concern that the Lower Monumental P&S development was ceased. Additionally, the 2000 Biological Opinion (RPA actions 120, 121 and 129) describes development of improved adult fishway entrance conditions by conducting hydraulic analysis of the systems, developing maintenance records and procedures,

and implementation of correctives measures as warranted. In FY 01, detailed hydraulic models will be developed and other alternatives will be studied consistent with alternatives at Little Goose, prior to reinitiating detailed P&S at Lower Monumental.

2. Major Activities/Tasks

- The Lower Monumental Adult Fishway System will be computer modeled to evaluate the upstream migrant systems as currently configured. Information will be collected to determine geometry and operational practice for fish ladder system. Model input files will be developed to simulate hydraulic conditions for current operation and a recommended operation. The model will be used to develop final recommendations on the best operation of the adult bypass systems and potential structural modifications to the system. These recommendations will go into to a final technical report. The model will be expandable to include any recommended changes to the system.

- The tasks will include: (a) collection of Project "as-built" drawings to define geometry and system controls for fish ladders, (b) development of hydraulic model to simulate the system, (c) verification of the model using existing data for the current operation of the system, (d) prepare report which describes the system geometry and operation, the computer model, verification of model, and preliminary recommendation to improve fish ladder operation, and (e) perform field verification of the model at low tailwater elevations.

- Phase II Report. Initiate work on Phase II of the EAWS system for the fish ladder at the Lower Monumental Project. This will be a feasibility level report in which alternatives identified in Phase I will be further investigated and defined as well as recommendations resulting from the computer model.

MILESTONE	DATE (MO/YR)
Complete Computer Model	Mar 2001
Complete Technical Report	Aug 2001
Begin Plans and Specifications	Oct 2001
Complete Plans and Specifications	Jun 2002
Phase I Construction	Jan 2003
Phase I System Startup and Testing	Feb 2003
Phase II Construction	Jan 2004
Phase II System Startup and Testing	Feb 2004
Complete Construction	Mar 2004

3. Cost Estimate

	FY02	FY03	FY04	FY05	FY06
Design/EDC	$300,000	$50,000	$50,000		
Construct		$2,400,000	$2,400,000		
Construct S&A		$300,000	$300,000		
AFEP (placeholder)		$250,000	$250,000	$250,000	$250,000
	$300,000	$3,000,000	$3,000,000	$250,000	$250,000

* Development of the above table, and absent a current recommended alternative, the costs are placeholder funds from the recommended alternative for Little Goose, as identified in the Phase II Technical Report dated Sept 2000 prepared by Sverdrup Civil Inc.

4. **Issues –** Construction is based on being able to complete the Technical Report in FY01, plans and specifications in early FY02, then starting construction late in FY02. A January-February construction window in the adult fishway is of short duration, and occurs during adverse weather conditions. The fishways must be operational during the adult fish migration periods, March through December, any construction delays can result in a full year impact to the schedule.

5. **RPA Action**

RPA	**CITATION**
Action 120	The Corps shall develop improved operations for adult fishway main entrances at FCRPS dams so that the best possible attraction conditions are provided for adult migrants, both at the four Columbia River hydro projects and the four lower Snake hydro projects (where reservoir elevations are held near MOP). The Corps shall report the findings of fishway entrance flow-balancing investigations in a report to NMFS by the end of 2001 and shall continue to work through FPOM to evaluate and implement, as warranted, structural changes to satisfy fish passage plan fishway entrance criteria.
Action 121	The Corps shall develop and maintain an auxiliary water supply, emergency-parts inventory for all adult fishways where determined necessary, in coordination with NMFS.
Action 129	The Corps shall complete adult fishway auxiliary water supply evaluations at each lower Snake River hydro project and implement corrective measures as warranted.

48. Little Goose Adult Fishway Auxiliary Water Supply

Multi-Year Plan

1. Project Information

- **Purpose/Objective** – Adult fishway auxiliary water supply systems provide fish attraction water flows to help migrating adult salmonids to find fish ladder entrances and to proceed up the fishways with minimum delay. The bypass of adult anadromous fish upriver for spawning is a critical portion of their life cycle. Hydraulic criteria have been established to facilitate the efficiency of their bypassing the dams by using upstream migrant systems. Compliance, where practicable, to these criteria is essential to operating the systems optimally. The adult fishway auxiliary water supply system at Little Goose has no spare or emergency capacity, and requires modifications to operate in accordance with the actions set forth in the Biological Opinion (Bi-Op). The general criteria established by the Bi-Op requires: (1) that auxiliary water system provide an emergency spare capacity equivalent to one pump above the maximum normal auxiliary flows, and (2) that electrical reliability should provide for 100% back-up in the event of an outage due to a single failure of either the bus, switchgear, or transformers feeding the turbine pump appurtenances. The objective for providing spare water supply capacity increases overall system reliability by providing emergency water supply for use during partial failures. It also increases the opportunity for practicing preventative maintenance on idle equipment without requiring system operation outside of the criteria established in the fish passage plan. In addition actual operating time on equipment will be reduced, increasing the overall useful operating life. By configuring the adult fishway system with spare water capacity and improved electrical reliability, fish passage plan criteria can be maintained, thus ensuring that the passage of adult salmonids through the system will be at the highest percentage with minimal delay.

- **Description -** The 2000 Bi-Op (RPA actions 120, 121 and 129) requires development of improved adult fishway entrance conditions by conducting hydraulic analysis of the systems, developing maintenance records and procedures, and implementation of corrective measures as warranted. Phase I and Phase II Technical Reports were led by the COE to review several alternatives to determine the most cost effective and reliably sound method to achieve the actions required by the Bi-Op. Since the dam was constructed, the existing auxiliary water supply system has proven to be very reliable. The existing auxiliary water supply system uses three hydraulic turbine-driven pumps with speed reducers to supply the auxiliary water to the lower fishway and the fish ladder lower diffusers. The recommended course of action is to construct a new emergency pumped supply utilizing the existing AWS pump intake, providing 850 CFS of EAWS flow to the AWS system. Three new electric motor-driven pumps will be installed in a new pump well, drawing water through openings created in the roof of the intake. Water will be pumped to Diffusers No. 1 and 2, which are isolated from the rest of the AWS system during operation of the EAWS system. The electric wicket gate operators, controlling flow to the turbines, are susceptible to a single-mode failure, which would render them without electrical actuation capability until repairs can be made. Modifications will be made to provide electrical redundancy to the wicket gate operators.

- A detailed hydraulic model will be developed for the Little Goose Adult Fishway system as recommended in the Bi-Op and utilized to confirm or suggest modifications to existing operational practices.

2. **Major Activities/Tasks -** At Little Goose it is recommended to install a new emergency pump system, an automatic transfer switch to the wicket gate operator circuit, add oil heaters to the speed reducers, and fund (through operations and maintenance funding sources) an increased spare parts inventory. The construction will take place over 2 years between the normal January-February ladder outages.

   - The Little Goose Adult Fishway System will be computer modeled to evaluate the upstream migrant systems as currently configured. Information will be collected to determine geometry and operational practice for fish ladder system. Model input files will be developed to simulate hydraulic conditions for current operation and a recommended operation. The model will be used to develop final recommendations on the best operation of the adult bypass systems and potential structural modifications to the system. The model will also be utilized to predict operational criteria as a result of implementation of the proposed alternative.

   - The tasks will include: (a) collection of Project "as-built" drawings to define geometry and system controls for fish ladders, (b) development of hydraulic model to simulate the system, (c) verification of the model using existing data for the current operation of the system, (d) prepare report which describes the system geometry and operation, the computer model, verification of model, and preliminary recommendation to improve fish ladder operation, and (e) perform field verification of the model at low tailwater elevations.

   - The Construction activities will include installation of a concrete pumping chamber, requiring excavation and shoring of materials at the existing AWS intake. Installation of new electric motor pumps, and associated control and electrical appurtenances.

   - Electrical redundancy will be added to the wicket gate operators by installing an automatic transfer switch to the control circuit, thus providing two sources of electrical power to the wicket gate operator circuit.

MILESTONE	DATE (MO/YR)
Complete Computer Model	Apr 2001
Complete Plans and Specifications	Aug 2001
Phase I Construction, Site Work	Jan 2002
Phase II Construction, Pump Station Structure	Jul 2002
Phase III Construction, Electrical, ATS, Oil Heaters	Aug 2002
System Startup and Testing	Jan 2003
Complete Construction	Mar 2003

3. **Cost Estimate**

ACTIVITY	FY02	FY03	FY04	FY05	FY06
Design/EDC	$250,000	$100,000			
Construction	$2,400,000	$2,400,000			
Construction S&A	$300,000	$300,000			
AFEP (placeholder)	$250,000	$250,000	$250,000	$250,000	$250,000
	$3,200,000	$3,050,000	$250,000	$250,000	$250,000

4. **Issues** – A January-February construction window in the adult fishway is of short duration, and occurs during adverse weather conditions. The fishways must be operational during the adult fish migration

periods, March through December, any construction delays can result in a full year impact to the schedule.

5. RPA Action

RPA	CITATION
Action 120	The Corps shall develop improved operations for adult fishway main entrances at FCRPS dams so that the best possible attraction conditions are provided for adult migrants, both at the four Columbia River hydro projects and the four lower Snake hydro projects (where reservoir elevations are held near MOP). The Corps shall report the findings of fishway entrance flow-balancing investigations in a report to NMFS by the end of 2001 and shall continue to work through FPOM to evaluate and implement, as warranted, structural changes to satisfy fish passage plan fishway entrance criteria.
Action 121	The Corps shall develop and maintain an auxiliary water supply, emergency-parts inventory for all adult fishways where determined necessary, in coordination with NMFS.
Action 129	The Corps shall complete adult fishway auxiliary water supply evaluations at each lower Snake River hydro project and implement corrective measures as warranted.

49. Ice Harbor Adult Fishway Auxiliary Water Supply

Multi-Year Plan

1. Project Information

- **Purpose/Objective** – Adult fishway auxiliary water supply systems provide fish attraction water flows to help migrating adult salmonids to find fish ladder entrances and to proceed up the fishways with minimum delay. The bypass of adult anadromous fish upriver for spawning is a critical portion of their life cycle. Hydraulic criteria have been established to facilitate the efficiency of their bypassing the dams by using upstream migrant systems. Compliance, where practicable, to these criteria is essential to operating the systems optimally. The adult fishway auxiliary water supply systems at Ice Harbor have no spare or emergency capacity, and require modifications to operate in accordance with the actions set forth in the Biological Opinion (Bi-Op). The general criteria established by the Bi-Op requires: (1) that auxiliary water system provide an emergency spare capacity equivalent to one pump above the maximum normal auxiliary flows, and (2) that electrical reliability should provide for 100% back-up in the event of an outage due to a single failure of either the bus, switchgear, or transformers feeding the pumps. The objective for providing spare water supply capacity increases overall system reliability by providing emergency water supply for use during partial failures. It also increases the opportunity for practicing preventative maintenance on idle equipment without requiring system operation outside of the criteria established in the fish passage plan. In addition actual operating time on equipment will be reduced, increasing the overall useful operating life. By configuring the adult fishway system with spare water capacity and improved electrical reliability, fish passage plan criteria can be maintained, thus ensuring that the passage of adult salmonids through the system will be at the highest percentage with minimal delay.

- **Description -** The 2000 Bi-Op (RPA actions 120, 121 and 129) requires development of improved adult fishway entrance conditions by conducting hydraulic analysis of the systems, developing maintenance records and procedures, and implementation of corrective measures as warranted. Phase I and Phase II Technical Reports were led by the COE to review several alternatives to determine the most cost effective and reliably sound method to achieve the actions required by the Bi-Op. Since the dam was constructed, the existing auxiliary water supply system has proven to be very reliable. Three electric motor-driven pumps each with a speed reducer supply the auxiliary water to the lower fishway and the fish ladder lower diffusers. However, this equipment has operated for 40 years and requires more than the standard overhaul and preventative maintenance work to assure continued reliable operation. The recommended course of action is to upgrade the existing pumps on the north shore, upgrade the electrical switchgear and provide redundancy, and provide additional bulkheads, cranes and hoists to facilitate routine O&M as well as emergency repairs. The south shore system will also receive upgrades to the electrical system components, providing improved reliability and redundancy. The pumping system already has spare capacity and no modifications are necessary to the mechanical systems.

2. Major Activities/Tasks - At Ice Harbor north shore system, it is recommended to upgrade and isolate the existing pump systems, modify the diffusers to allow more flow, install cranes for access and maintenance, and fund (through operations and maintenance funding sources) maintenance on existing systems and upgrade spare parts inventory. For the south shore system, it is recommended to upgrade and isolate the existing pump systems and fund (through operations and maintenance funding sources) maintenance on existing systems and upgrade spare parts inventory. The construction will take place over 4 years to allow for one ladder to be in operation at all times.

MILESTONE	DATE (MO/YR)
Phase I Construction on North Shore System	Jan 2002
Phase I System Startup and Testing	Feb 2002
Phase II Construction on North Shore System	Jan 2003
Phase II System Startup and Testing	Feb 2003
Phase III Construction on South Shore System	Jan 2004
Phase III System Startup and Testing	Feb 2003
Phase IV Construction on South Shore System	Jan 2005
Phase IV System Startup and Testing	Feb 2003
Complete Construction	Mar 2005

3. Cost Estimate

ACTIVITY	FY02	FY03	FY04	FY05	FY06
Design/EDC	$20,000	$20,000	$20,000	$20,000	
Construction	$2,600,000	$2,000,000	$1,500,000	$1,500,000	
Construction S&A	$260,000	$200,000	$150,000	$150,000	
AFEP (placeholder)		$250,000	$250,000	$250,000	$250,000
	$2,880,000	$2,470,000	$1,920,000	$1,920,000	$250,000

4. Issues – **Issues** – A January-February construction window in the adult fishway is of short duration, and occurs during adverse weather conditions. The fishways must be operational during the adult fish migration periods, March through December, any construction delays can result in a full year impact to the schedule.

5. RPA Action

RPA	CITATION
Action 120	The Corps shall develop improved operations for adult fishway main entrances at FCRPS dams so that the best possible attraction conditions are provided for adult migrants, both at the four Columbia River hydro projects and the four lower Snake hydro projects (where reservoir elevations are held near MOP). The Corps shall report the findings of fishway entrance flow-balancing investigations in a report to NMFS by the end of 2001 and shall continue to work through FPOM to evaluate and implement, as warranted, structural changes to satisfy fish passage plan fishway entrance criteria.
Action 121	The Corps shall develop and maintain an auxiliary water supply, emergency-parts inventory for all adult fishways where determined necessary, in coordination with NMFS.
Action 129	The Corps shall complete adult fishway auxiliary water supply evaluations at each lower Snake River hydro project and implement corrective measures as warranted.

50. Adult PIT Tag Monitoring
Bonneville, The Dalles, John Day

Multi-Year Plan

1. Project Information

- **Purpose/Objective:** The goal of the program is to develop, install and evaluate adult Passive Integrated Transponder (PIT) tag interrogation systems in adult fishways (fish ladders) throughout the Federal Columbia River Power System (FCRPS). Most Corps operated hydroelectric facilities have the ability to detect juvenile salmonids that have been tagged with PIT tags as they pass through bypass systems. However, detection of returning adults is needed to determine the effectiveness of juvenile survival measures.

- **Description:** The present plan calls for the development and installation of adult PIT tag interrogation systems in all of the adult fish ladders at the Bonneville project for use beginning in 2002. A prototype system, previously tested in the lab, is being installed in the Washington Shore ladder at Bonneville for evaluation in 2001. The primary purpose of the prototype is to determine antenna numbers and locations needed to achieve acceptable reading efficiency. Visual evaluation will help verify efficiency and behavioral changes, if any, and will establish baseline proportions of adult salmonids that use orifices and overflow weir sections.

2. Major Activities/Tasks: In 2002, work will include completing the design and construction of the interrogation system for all four Bonneville fish ladders. Evaluation of the systems will follow construction. This plan assumes that the regional stakeholders will request installation of these systems on all FCRPS fish ladders once Bonneville is fully outfitted.

Milestone	Date (Mo/Yr)
Complete Prototype Installation at Bonneville (Washington Shore Ladder)	Feb/01
Presentation of Prototype Results	Nov/01
Complete Production Installation at Bonneville (All Four Ladders)	Feb/02
Presentation of Production Results	Nov/02
Complete Design and Installation at The Dalles and John Day Projects	Feb/03
Presentation of Full District Implementation Results	Nov/03

3. Cost Estimate:

Activity	FY02	FY03	FY04	FY05	FY06
Prototype Evaluation	100				
Production Installation (Bonn)					
Plans and Specs	100				
Construction	1500				
Biological Evaluation	100	100			
Production Installation (The Dalles and John Day)					
Plans and Specs	200	100			
Construction		2000			
Biological Evaluation		200	200		
TOTALS	**2000**	**2400**	**200**		

4. **Issues:** Installation of adult PIT tag interrogation systems at The Dalles and John Day projects has not been coordinated or agreed to by regional stakeholders.

5. **RPA Action:** Biological Opinion measure Nos. 50 and 192. "The Corps and BPA shall install necessary adult PIT-tag detection at appropriate FCRPS projects before the expected return of adult salmon from the 2001 juvenile outmigration."

51. McNary Adult Pit Tag Monitoring

Multi-Year Plan

1. Project Information

- **Purpose/Objective** – The bypass of adult anadromous fish upriver for spawning is a critical portion of their life cycle. Installation of pit tag antennas in the upstream migrant system, in accordance with the actions set forth in the Biological Opinion (Bi-Op), will provide tracking and research capability of all returning pit tagged adult salmon. The objective for monitoring the passage of adult salmon migrating upstream provides specific biological information regarding issues such as: (1) survival rates between dams and through the system; (2) partition interdam losses by factor; (3) Assess causal mechanisms associated with losses; (3) assess reproductive success; and (4) identifying factors affecting passage, survival, and reproductive success. Evaluation of factors effecting upstream migratory efficiency will be utilized to reduce site-specific hindrances, thus ensuring that the passage of adult salmonids through the system will be at the highest percentage with minimal delay.

- **Description -** The 2000 Bi-Op (RPA action 50) requires development installation of necessary adult PIT-tag detectors at various FCRPS sites. The work at McNary will be coordinated with prototype testing of similar antennas at Bonneville. Due to the revised operating characteristics of the new PIT tag system, appropriate site testing must be made to evaluate the operation of the antennas on a limited basis, prior to full-scale implementation.

  - The effects of Radio Frequency Interference (RFI) and Electro-Magnetic Interference (EMI) on the PIT tag system will be investigated by installing antennas at two test locations in both the Oregon and Washington Ladders. National Marine Fisheries Service (NMFS) is leading the test procedures and providing and installing the PIT-tag detector equipment.

  - Test locations will be coordinated the NMFS for ease of access, and potential for permanent installation. Prototype testing will be made for antennas installed in the fish ladder weirs, and for external antennas installed above the fish ladder water level. Testing will occur at the Oregon Ladder in FY 2001, and at the Washington Ladder in FY02.

  - Pending favorable results from the test locations, plans and specifications will be developed for either the submersed or external antennas, with construction scheduled for completion in March 2003.

2. Major Activities/Tasks

- Prepare plans and specifications for prototype testing of PIT-tag antenna locations through FY02.

- Prepare plans and specifications for permanent installation of PIT-tag antennas for FY03.

- Depending on the type of antenna to be installed, the fieldwork will differ dramatically. Antennas installed in the fish ladder weirs require saw-cut modifications to the orifices and fish ladder floor. Externally installed antennas may require additional shielding form RFI and EMI sources that won't be identified until completion of the prototype testing.

- Install electrical service to support antenna installation and receiver electronics. Most of this work can be accomplished outside of the ladder outage construction window.

- Depending on the final location and quantity of PIT-tag detectors installed, a support facility may need to be constructed to house all of the computers and instrumentation associated with the PIT-tag system.

MILESTONE	DATE (MO/YR)
Complete Prototype Testing Oregon and Washington Shore Ladders	Aug 2001
Complete Plans and Specifications for Permanent Installation	June 2002
Phase I Construction, Electrical Site Work	Oct 2002
Phase II Construction, Antenna Installation	Jan 2003
Complete Construction	Mar 2003

3. Cost Estimate

ACTIVITY	FY02	FY03	FY04	FY05	FY06
Design/EDC	$250,000	$60,000			
Construction		$400,000			
Construction S&A		$40,000			
AFEP (placeholder)		$250,000	$250,000		
	$250,000	$750,000	$250,000	$ 0	$ 0

4. Issues – If submersed antennas are required at the McNary site, all saw-cutting, installation of antennas, and grouting repair must be performed in the January-February construction window during the ladder outage. All of the ladder work will be have to be accomplished and during adverse weather conditions. Any construction delays can result in a full year impact to the schedule.

5. RPA Action

RPA	CITATION
Action 50:	BPA and the Corps shall install necessary adult PIT-tag detectors at appropriate FCRPS projects before the expected return of adult salmon from the 2001 juvenile outmigration.

52. Adult Upstream Migration Studies

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - Adult salmon and steelhead migrating to their natal streams in the Columbia River Basin must pass up to eight or nine Columbia and Snake river dams. In some years, research has indicated mortality and unaccounted for losses potentially associated with the FCRPS. Mortality and reduction in reproductive success due to conditions caused by the FCRPS must be minimized in order to maintain and recover native runs of fish in the basin. The goal is to maximize reproductive success by minimizing direct and indirect migrational problems. Funding is through the FCRMP.

- **Descriptions** - Since 1990, the Corps and Bonneville Power Administration have funded research on the upstream migration of adult salmon, steelhead and in 1995 Pacific lamprey through the FCRPS and into tributaries. Fish were tagged with radio-transmitters and tracked past dams and through reservoirs from 1991-1994 in the Snake River and 1996 – 1998 in both the Snake and Columbia rivers. Results of the Snake River study reported migration characteristics, fishway passage parameters, and project operations effect on passage behavior (Bjornn, et al., 1998). Although 1999 was devoted to analyzing and reporting information collected from 1996-98, the analyses and reporting are not yet complete and are ongoing.

  In FY00, additional radiotelemetry studies were added to: assess the effects of additional spill for juveniles on adult migrant fallback rates; evaluate transition pool modifications to reduce migration delay; evaluate fallback and delay in juvenile bypass systems; and assess temperature and gas exposure history for adult migrants. In addition, two studies to assess the delayed effects of dam passage on the survival and reproductive success of adult chinook salmon were initiated in 2000. One study used biotelemetry to estimate the energetic cost of dam passage and the other to develop non-lethal lipid estimation techniques.

  Activities for FY01 will include continuation of some of the radiotelemetry objectives: interdam loss, fallback through spill, turbines, and juvenile bypasses, temperature and gas exposure, and transition pool modifications among other studies. Unaccounted for loss and fallback through turbines are being pursued more aggressively in 2001 in order to better understand or estimate these events. The biotelemetry pilot study will move from developing relationships in the laboratory in 2000 to the field study element at Bonneville Dam in 2001. Energy expenditure will be measured as fish migrate through the dam and reservoir. These values will be used along with energy budget data to assess the long-term implications of events such as fallback and delay on survival and reproductive success. Depending on results of non-lethal lipid estimation pilot work in FY00, a field study to estimate the amount of energy reserves consumed on a system-wide basis by adult chinook salmon may be initiated. In addition to conducting the above studies in FY01, draft reports addressing all of FY00 radiotelemetry study objectives will be done by September 2001.

  Continuing and potential adult radiotelemetry work in upcoming years include studies of: straying; temperature effects; unaccounted for loss; fallback; entrainment in juvenile bypass systems; survival and reproductive fitness; Pacific lamprey; turbine and spillway passage; and migratory delay. In addition, adult PIT detection will be in place at select dams in the system and physiological studies will be performed, both of which will enhance the understanding of the impact of the FCRPS.

2. **Major Activities/Tasks –** The major tasks include fieldwork through FY05 and completion of reports for all years except some objectives from 2005 field work will not be completed until 2007.

Milestone	Date (Mo/Yr)
Adult Telemetry Evaluation of Migration, Fallback, Loss and Delay on Spawning Success. - Report	March 2003
Energy Dynamics of Adult Migration – March	March 2003
Migration Delays, Passage Routes and Energy Costs on Spawning – Report	March 2003

3. **Cost Estimate**

FY02	FY03	FY04	FY05	FY06
$3,000k	$3,000	$3,000	$3,000	$3,000

***** Costs are depending on the critical objectives built on the previous year of research.

4. **Issues** – Any actions to enhance the reproductive success of adult salmonids need addressing.

5. **RPA Action**

- Action 107. "The Action Agencies shall conduct a comprehensive evaluation to assess survival of adult salmonids migrating upstream and factors contributing to unaccounted losses."

- Action 111. "The Corps shall investigate and enumerate fallback of upstream migrant salmonids through turbine intakes at all lower Snake and Lower Columbia river dams. The Corps shall implement corrective measures to reduce turbine mortality, as warranted."

- Action 113. "The Corps shall investigate measures to reduce adult steelhead and salmon fallback and mortality through the Bonneville Dam spillway. A final report shall be submitted to NMFS stating the findings of these investigations and recommending corrective measures. Potential remedies shall be included in the annual planning process."

- Action 115. "The Corps and BPA shall conduct a comprehensive depth and temperature investigation to characterize direct mortality sources at an FCRPS project considered to have high unaccountable adult losses (either from counts and/or previous adult evaluations)."

- Action 116. "The Corps shall investigate adult fish delay and fallback at ladder junction pools and implement remedies to reduce this problem as warranted."

- Action 117. " The Corps shall evaluate adult count station facilities and rehabilitate where necessary at all projects to either minimize delay of adults or minimize counting difficulties that reduce count accuracy."

- Action 118. "The Corps shall develop and implement a program to better assess and enumerate indirect pre-spawning mortality of adult upstream migrating fish. Such mortality may be due to or exacerbated by , passage through the FCRPS hydro projects. If measures are identified which will reduce the unaccountable loss rate and/or the pre-spawning mortality rate, the Corps shall implement these measures as warranted. The program should also enhance efforts to enumerate unaccountable losses associated with tributary turnoff, harvest, or other factors in FCRPS mainstem reservoirs and upstream of FCRPS projects."

- Action 119 - The Corps shall ensure that alterations to fish ladders and adult passage facilities to accommodate Pacific lamprey passage do not adversely affect salmonid passage timing and effects.

- Action 199 - The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H.

54. Fish Ladder Temperature Evaluation

Multi-Year Plan

1. Project Information

- **Purpose/Objective** There is evidence that indicates temperature gradients elicit a behavioral response in adult steelhead and, to some extent, adult chinook salmon. This is demonstrated by the holding behavior of adult steelhead and chinook salmon in response to temperature differences at the confluence of the Snake and Columbia Rivers. During mid summer when the Snake River warms more quickly than the Columbia River, and river temperatures are nearing the lethal limit for salmonid, some steelhead and chinook salmon hold for several weeks in the Columbia River. They enter the Snake River after temperatures have started to decline and the temperatures of the two rivers converge. This holding behavior is seen again as steelhead approach the confluence of the Clearwater River. In addition, several fish passage delays have been reported during temperature differences near adult fishways. Temperature differences of a few degrees at the confluence of the Lower Columbia and Snake Rivers and at fishways at other dams have caused adults to delay; it is logical to assume adults may behave in a similar manner when they encounter a temperature difference in or near the lower Snake River adult fishways. In addition, several occurrences of fish passage delays caused by temperature differences near adult fishways has been observed. Sockeye and steelhead passage was reduced at a Columbia River fishway that was heated to temperatures four degrees Celsius above the ambient river temperatures. A similar temperature blockage has been reported at the Pelton Dam on the Dechutes River (Oregon) during the summer when temperature differences ranged between six to eight degrees Celsius.

  Temperature data collected in the adult fishways have shown a differences occurs between the fish ladders and the tailrace temperatures. In general, these temperature differences are less than two degrees Celsius. However, during late summer in years of warm weather and low flows, a temperature difference of greater than two degrees Celsius can occur. To date, the largest temperature difference recorded is four and one-half degrees Celsius in 1992 at Lower Granite. If temperature differences of a few degrees at the confluence and at fishways at other dams may cause adults to delay, it is logical to assume adults may behave in a similar manner when they encounter a temperature difference in or near the lower Snake River adult fishways.

  This project is funded from the Columbia River Fish Mitigation Program. The long-term objective of this study has been to define any problems that may exist specific to effects of fish ladder water temperature on adult salmon and steelhead and to determine feasible methods of mitigating any adverse affects. This effort will be a combined Walla Walla/Portland District project evaluating all project ladders.

- **Description -** Temperature data is routinely monitored by project biologists. In addition, additional data was collected beginning in 1995 for Ice Harbor and McNary projects including forebay profiles. Other datasets exist for other projects and studies. The approach is to compile existing data, review for quality and compile into a database.

2. Major Activities/Tasks

Beginning in fiscal year 2001, temperature data that has been gathered in and around adult fish ladders on all of the Corps eight projects over the years will be collected and entered into a combined database for analysis. Quality assurance checks will be performed on existing data and some limited analysis will be conducted. A white paper will be prepared assessing data needs, data quality, and will identify any obvious problem areas based on the limited analysis conducted. Preparation of the white paper is likely to continue into FY02. Recommendations, from the report, will shape future

data collection needs and analysis and identify future reporting. Currently planned data collection will continue while the white paper is being prepared. Recommendations for redirecting data collection efforts (locations, quantity etc.) in the future are anticipated.

Milestone(10pt)	**Date (Mo/Yr)** (10pt)
Compile data into database	October 2001
Conduct analysis and prepare White Paper	December 2001.
Collect additional data	

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$300k				

4. Issues

5. RPA Action

- Action 114 - The Corps shall examine existing fish-ladder water temperature and adult radio-telemetry data to determine whether observed temperature differences in fishways adversely affect fish passage time and holding behavior. If non-uniform temperatures are found to cause delay, means for supplying cooler water to identified areas of warmer temperatures should be developed and implemented in coordination with the annual planning process.

- Action 115 - The Corps and BPA shall conduct a comprehensive depth and temperature investigation to characterize direct mortality sources at an FCRPS project considered to have high unaccountable losses (either from counts and/or previous adult evaluations).

55. Adult Temperature Evaluations Relevant to Fishways, Dam Passage, and System Management

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - Water temperature has the potential to effect the migration behavior of adult salmon (rate of passage, delays, wondering/straying, and survival through the hydrosystem), it also impacts the physiological processes that make spawning successful (egg viability and energy expenditure). Thus, the exposure to the longer duration of high temperatures during dam passage and through the tailraces, fishways and forebays are thought to be a significant contributor to adult salmon passage delays, losses of adults upstream of Lower Granite, and reduced spawning success.

  In recent years water temperatures have been recorded as high as 24 ° C in the fishways and forebays of the Lower Snake River dams. It is important to note that this temperature is near lethal levels for salmon, it is also 10° C above the optimal migrating temperature, and about 8° C above the temperature level that causes, even at short term exposures, a reduction of reproductive potential. Water temperatures encountered by adult salmonids migrating through the lower Snake River are higher and the period of high water temperatures is of longer duration than the temperatures that were encountered prior to construction of upriver storage reservoirs. Optimum migration temperature for chinook salmon is 14 ^{o}C and adult steelhead have been reported delaying at the entrance into the Snake River until water temperatures drop to 21 ^{o}C. Cold water releases from Dworshak Reservoir in the North Fork of the Clearwater River have reduced water temperatures in the lower Snake River. Although the extent to which high water temperatures may compromise the ability of adult salmonids to migrate to spawning grounds and successfully spawn is unknown, fish held in hatcheries at temperatures above 15.6 ^{o}C have a lowered reproductive potential.

  Little is known about the existence of cool water areas in the lower Snake River and their possible use by migrating adult salmonids. Previous telemetry studies have shown that steelhead migrating through the lower Columbia River enter the mouths of cooler tributaries possibly using them as temporary refuges from the higher water temperatures encountered in the mainstem of the Columbia River

  - **Description -** During the relative ranking (for fish benefits) of construction actions being developed to improve passage at the hydroprojects and river system, it is important to consider the impact of temperature exposure on the long term success of adult upstream migration and successful spawning. Actions that may appear to cause non-significant passage delay with respect to time may in-turn be causing an unacceptable level of high temperature exposure. Baseline information is necessary to evaluate the consequences, and interaction of temperature with the different passage routes, fallback, delays and construction actions related to fishways, and spillway improvements necessary to maintain a successful adult upstream migration (i.e. productivity of spawning, egg viability). Without baseline information on temperature exposure to adult fish passing through the fishways, dams and hydrosystem, and the behavioral responses, we may unintentionally delay a construction action that may reduce the impacts of exposure on reproductive success during critical times of poor water quality.

    Product – Baseline Information:

- Fishway Improvements to Reduce Passage Delays - Includes actions that help to improve the passage through the hydroproject and reduce exposures to high temperature and dissolved gas, such as:
  - Ladder Temperature Control
  - Transition Pools Improvements
  - Fishway Fallout
  - Fishway Entrance Delays

- Modifications that Effect Delay - Actions that affect migration behavior in the tailraces increased time spent in the tailrace during spill and high levels of dissolved gas and provide migration behavior information that helps to determine if adult fish modify their migration routes to accommodate for poor water conditions.
  - Spill and Dissolved Gas Compensation
  - Fallback through Spill and Surface Collectors
  - Collection Channel Holding
  - Structures to De-stratify Forebay Thermal Profiles

- Delays Related to System Management - Provide additional information on the environmental conditions that are encountered during straying and wandering. This will help to separate the environmental effects that cause delay (temperature) from delays that may be caused by a reduction in the homing ability of adults that were transported as juveniles or exposure to multiple bypass systems.

2. Major Activities/Tasks -

A telemetry study shall be conducted to document the temperature (and depth) histories of adult fish during their upstream migration. Results of the baseline evaluation shall provide temperature exposure (and depth of passage) information that will be used by the Corps in several ongoing efforts.

- Pilot Study – August 1999 through March 2000
- Field Season - January 2000 through November 2004
- Final Report - December 2005

a. Adult fish will be tagged with radio/depth and temperature data loggers, track through the hydrosystem to their spawning ground to correlate temperature exposure history to spawning productivity, identify potential trouble areas within the adult fishways, impacts caused by fallback and passage delays and to correlate passage to areas of cool water refugia.

To initiate this study, a pilot study was conducted in late FY99 and FY00 to determine if the proposed technology will provide the data needed to correlate passage behavior to environmental characteristics of depth and temperature. Adult fish (chinook and steelhead) were marked at Ice Harbor Dam and successfully tracked through the Snake River hydroprojects utilizing new depth and temperature recording radio tags. Preliminary information from this effort has already provided passage information for the passage problems in the adult fishway transition pools. The full study is planned for three consecutive years to incorporate annual variability into the data set.

b. To complement the adult telemetry study water temperature monitoring is being conducted in the adult fishways and in the forebays, and profiles 2,000 ft. upstream of the dam. In addition, water temperature profiles in the reservoirs will also be collected throughout the Snake River and extensively in the Lower Granite reservoir, including the confluence of the Snake and Clearwater Rivers.

c. A model that will be developed to calculate/estimate the expected migration routes for adult salmon and steelhead based on water temperature, dissolved gas and water velocities. This will be used to relate the physical river environment to the migration behavior of adult steelhead and salmon. The MASS 2D depth-averaged model originally developed for the DGAS Program dissolved gas model is being expanded to include an additional upstream area. The model will be modified to include a

method to estimate vertical temperature profile for the designated sample cells and potentially a 3D simulation of the confluence areas.

Milestone	Date (Mo/Yr)
Adult Monitoring FY01 - Complete	December / 2001
Installation of Radio Receivers – Snake and Columbia	April / 2001
Temperature Monitoring	October / 2001
Biostatistical Review FY00 – Complete	July/2001
Temperature Modeling	August 2002
Radio Telemetry Letter Report	December 2002
Dworshak Releases Experimental Study Plan	September 2001

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
990,000	**1,120,000**	**1,120,000**	**680,000**	**550,000**

4. Issues – Insufficient flows available for cool water releases from Dworshak may impact the implementation or delay an evaluation of the potential benefits of these releases on adult passage, migration behavior and fecundity.

5. RPA Action

- **Directly Supports Reasonable and Prudent Alternative:**

Action 115: "The Corps and BPA shall conduct a comprehensive depth and temperature investigation to characterize direct mortality sources at an FCRPS project considered to have high unaccountable adult losses (either from counts and/or previous adult evaluations)."

Action 34: "The Action Agencies shall evaluate potential benefits to adult Snake River steelhead and fall chinook salmon passage by drafting Dworshak Reservoir to elevation 1,500 feet in September. An evaluation of the temperature effects and adult migration behavior should accompany a draft of Dworshak Reservoir substantially below elevation 1,520 feet."

- **Indirectly Supports Reasonable and Prudent Alternative:**

Action 114: "The Corps shall examine existing fish-ladder water temperature and adult radio-telemetry data to determine whether observed temperature differences in fishways adversely affect fish passage time and holding behavior. If non-uniform temperatures are found to cause delay, means for supplying cooler water to identified areas of warmer temperatures should be developed and implemented in coordination with the annual planning process."

Action 116: "The Corps shall investigate adult fish delay and fallback at ladder junction pools and implement remedies to reduce this problem, as warranted."

Action 199: "The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H."

56. Adult Fish Transition Pool Evaluations

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - The impacts of delay on adults during their upstream migration are unknown. However, delays in the upstream migration have been assumed to impact energy consumption, spawning productivity (due to prolonged exposure to high temperature), and the health and survival of the adult (as a result of exposure to high levels of dissolved gas). Although there is no direct evidence that delays of a specific duration will result in a reduction to survival, spawning or fecundity, the elimination of factors that contribute to delay are deemed to be the prudent course of action. Sources of delay through the hydrosystem include the accumulative delay caused by adult salmon falling out of the adult fishways at the hydroprojects.

  Approximately 70% of the adult salmon migrating upstream turn around near the transition pool in the adult fishways at the Columbia and Snake River Dams. Of the fish that turn around and move down the fishway approximately 50% fallout of the fishway back into the tailrace. Adults that have fallen out of the fishway may reenter the fishway immediately or may delay several hours in the tailrace. The average, accumulative hydrosystem delay due to fallout of the fishway is approximately 3 to 4 additional days to the migration through the hydrosystem.

  Although the harm caused by fallout delay to adult spawning survival, success and productivity have not been demonstrated, improvements to the adult fishways and ladders are being investigated to eliminate the causes that induce turn around and fallout. Areas within the fishway that have shown a consistent problem regardless of species, season and hydroproject are the transition pools (the junction of the base of the ladder, the collection channel and a fishway entrance).

- **Description** - This project investigates the factors that stimulate the adult salmon to turn around in this area and evaluates solutions to this problem. Once the specific causes are identified, solutions will be tested at adult fish ladder on the Snake and Columbia Rivers.

  Product – Baseline Information
  Several processes occur within this area that make it difficult to identify the dominant factor that stimulates fish to turn around. The transition area is laden with the following problematic conditions:

  Low velocities through the transition pool. Measurements taken at Little Goose have shown that flows through the transition pool are less than 0.5 fps and less than 0.5 fps through the orifices in the lower weirs of the adult fish ladder (LGO). Attraction flows through the orifice should be greater than 4 fps;

  Submerged weirs may act as a physical obstruction or barrier. The first weir in which a fish must pass through or over is encountered immediately upstream of the transition pool area. In this confusing environment, the weir may be perceived as an obstruction instead of a passage route.

  Confusing flows and eddies caused by the junction of the entrances, ladder and channel and the vertical upwelling flow that originate from the auxiliary water supply system. Seasonal temperature gradients that may have the greatest difference over the auxiliary water supply diffusers may also contribute to confused behavior in the adult salmon in this area.

2. Major Activities/Tasks -

It should be noted that fishway fallout and delay is likely the combination of more than one problem with the adult fishway. Once turn around is initiated at the transition pool, factors contribute to the fish moving out of the fishway through an entrance into the tailrace. Also, after the fish has returned to the tailrace other factors contribute delay on re-entry. If turn around near the transition pool can be eliminated or reduced the other factors that contribute to fallout and tailrace delay have less opportunity to exert an influence on the adults.

a. Review data to isolate the location at which the majority of the fish turn around in the transition pool and lower fish ladder, FY99 and FY00. Based on the analysis of data from fish passage at several fishways most of the fish were observed to turn around in the submerged weir section of the ladder. Although this data is limited for Little Goose and Lower Granite, turn around is expected to occur at the submerged weir section. This is based on the consistency at which this pattern is observed in the ladders at the downstream projects.
    - Data Review - January 1999 through November 2001
    - Annual Presentation – November 2001
    - Letter Report - June 2001

b. Determine the common route of passage through the submerged weirs, orifices or over the weirs. As part of the pilot study to evaluate the temperature histories of adult salmon, the depths at which fish pass through the Lower Granite ladder were monitored, FY99 and FY00. Base on the result of this pilot study, most of the fish appeared to use the orifices to pass the submerged weir section of the adult ladder. This information elevates the importance of orifice flow velocities over the other conditions in the transition pool that may contribute to adult fish turn around.
    - Pilot Study - August 1999 through November 2001
    - Annual Presentation – November 2001

c. Investigate the effects that an increase in velocities through the submerged weir orifices has on adult salmon turn around in the transition pool area. This is being accomplished by increasing the head differential over the submerged weir section of the Lower Granite ladder. The modifications should restrict the flow enough to create at least a 0.25 head differential across the weirs so that the velocity through the submerged orifices is at least 4 feet per second. The initial design is for a temporary modification suitable for prototype field-testing.
    - Design a raised weir for the first five submerged weirs - December 1999
    - Construct raised weir - May 2000
    - Adult fish passage telemetry evaluation of the prototype weirs.
        - Field Season - January 2000 through November 2002
        - Final Report - December 2003
            Annual Reports due in March
            Annual Presentations due in November
            Annual Study Plans presented to SRWG in September

d. Depending on the results of the raised weir evaluations, investigations shall focus on reducing the turbulence, eddies, confusing direction and to increasing the velocities of the flows in and near the transition pool area. An alternate concept is the construction of a pair of wing-walls to help smooth out the flows as they transition from the junction pool to the collection channel. Higher velocities and less confusing flows at this location may help fish to move out of the collection channel and into the transition pool area. This may reduce the fallout of fish that previously would have turned around in the transition pool by quickly attracting them to move back upstream toward the ladder; away from the fishway entrances.
    - Design and construct fishway wing walls - July 2002 to April 2003
    - Evaluate the success of the prototype in reducing adult fish fallout and improve fish passage behavior. - January 2003 -2006

e. The intent of testing these concepts at Lower Granite is to identify the hydraulic condition that triggers the turn-around behavior in adult salmon. Once this stimulus has been isolated, concepts and solutions will be developed, designed and implemented for each adult fish ladder at the Snake and Columbia river dams. If the results of the raised weir concept are promising then testing, design and implementation at other adult fish ladder may start as soon as Fiscal Year 2003. If the results to the evaluations are unclear implementation actions will be delayed.

Milestone	Date (Mo/Yr)
Letter Report - Problem Analysis	June 2001
Raised Weir Evaluation - Final Report	December 2003
Evaluation of Fishway Wing-Walls	Pending *
Test Design and Implement at Other Adult Fish Ladder - Start	December 2003

* Initiation of this work will depend on the results of the raised weir evaluation.

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
350,000*	**450,000***	**Construction**	**Construction**	**Construction**

* If modifications are required the costs will increase.

4. Issues – This work requires the handling and marking of adult fish destined for the Snake River. Insufficient marked adults will compromise the study and thus, delay the implementation of this action. In addition, implementation of this action may require modifications to other adult fish ladders for evaluation purposes. These modifications may require work in the adult fishway outside of the in-water work window. Once permanent solutions have been identified implementation will proceed at each adult ladder as appropriate. The permanent solution will require construction modifications that may require the adult fish ladders to be out of service for a period that exceeds the scheduled outage and current in-water work window. As always construction actions will be coordinated to reduce impacts to fish.

5. RPA Action

- **Directly Supports Reasonable and Prudent Alternative:**

Action 116: "The Corps shall investigate adult fish delay and fallback at ladder junction pools and implement remedies to reduce this problem, as warranted."

- **Indirectly Supports Reasonable and Prudent Alternative:**

Action 114: "The Corps shall examine existing fish-ladder water temperature and adult radio-telemetry data to determine whether observed temperature differences in fishways adversely affect fish passage time and holding behavior. If non-uniform temperatures are found to cause delay, means for supplying cooler water to identified areas of warmer temperatures should be developed and implemented in coordination with the annual planning process."

Action 199: "The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H."

57. Adult Lamprey Passage

Multi-Year Plan

1. Project Information

- **Purpose/Objective:** The goal of the program is to develop upstream migrant facilities at Bonneville Dam that will pass adult Pacific Lamprey without disrupting adult salmon and steelhead passage. [Pacific Lamprey populations have declined severely since the completion of the Federal Columbia River Power System. In 1993, the Oregon Department of Fish and Wildlife designated Pacific Lamprey at risk of being listed as threatened or endangered. Only 40% of fish released below Bonneville successfully pass the dam.

- **Description:** The development and evaluation of alternative passage facility concepts in the experimental ladder, the design and construction of prototypes for selected alternatives and the evaluation in the field of those prototypes. In 1995, the Corps initiated a radio telemetry evaluation of adult lamprey, which indicated a low passage rate at Bonneville Dam. Several problem areas were isolated. These include the fishway entrances, entrance pools and count stations. In 1999, a test ladder was constructed to evaluate swimming performance and behavior in ladders and to test ladder modifications.

2. Major Activities/Tasks: In 2001, the Corps is evaluating a prototype in the collection channel of powerhouse 2 using radio telemetry. The prototype structure will consist of strips of plating placed over a section of floor diffuser grating, thus providing the lamprey an area to attach and rest as they make their way up the channel. Also, a spillway entrance is being modified to have smoother, rounder edges and this will be evaluated at different head conditions. Blood chemistry will also be assessed throughout the year to help understand physiological changes, sexual maturation, and migration readiness. In 2002 and beyond, there will continue to be testing of different concepts in the test ladder and construction of prototypes for evaluation. There will likely be several iterations before final corrective measures are recommended, designed, constructed and evaluated.

Milestone	Date (Mo/Yr)
Award 2001 Study Contracts	Jan/01
Presentations of 2001 Results	Nov/01
Award 2002 Study Contracts	Jan/02
Presentations of 2002 Results	Nov/02
Award 2003 Study Contracts	Jan/03
Presentations of 2003 Results	Nov/03
Complete Final Design Report w/ Recommendation	Nov/04
Complete Construct Final Corrective Measures	Feb/06
Award Study to Evaluate Corrective Measures	Jan/06
Presentation of Final Evaluation Results	Nov/06

3. Cost Estimate:

Activity	FY02	FY03	FY04	FY05	FY06
Test of Concepts	100	100			
Construct, Evaluate Prototypes	450	450			
Physiological Evaluation	65	65			
Final Design Report			350	100	
Construct Final Design				350	1000
Evaluate Final Design					350
TOTALS	**615**	**615**	**350**	**450**	**1350**

4. Issues: FY02 program is twice FY01 funding level. Corrective measures must not adversely affect salmon passage (timing and success).

5. RPA Action: Biological Opinion measure No. 119

58. Marine Mammal Predation at Bonneville Tailrace [*Under Development*]

59. Investigate Adult Headburn [*Under Development*]

60. Adult PIT Tag Program
Bonneville, The Dalles, John Day

Multi-Year Plan

1. Project Information

- **Purpose/Objective:** The goal of the program is to develop, install and evaluate adult Passive Integrated Transponder (PIT) tag interrogation systems in adult fishways (fish ladders) throughout the Federal Columbia River Power System (FCRPS). Most Corps operated hydroelectric facilities have the ability to detect juvenile salmonids that have been tagged with PIT tags as they pass through bypass systems. However, detection of returning adults is needed to determine the effectiveness of juvenile survival measures.

- **Description:** The present plan calls for the development and installation of adult PIT tag interrogation systems in all of the adult fish ladders at the Bonneville project for use beginning in 2002. A prototype system, previously tested in the lab, is being installed in the Washington Shore ladder at Bonneville for evaluation in 2001. The primary purpose of the prototype is to determine antenna numbers and locations needed to achieve acceptable reading efficiency. Visual evaluation will help verify efficiency and behavioral changes, if any, and will establish baseline proportions of adult salmonids that use orifices and overflow weir sections.

2. Major Activities/Tasks: In 2002, work will include completing the design and construction of the interrogation system for all four Bonneville fish ladders. Evaluation of the systems will follow construction. This plan assumes that the regional stakeholders will request installation of these systems on all FCRPS fish ladders once Bonneville is fully outfitted.

Milestone	Date (Mo/Yr)
Complete Prototype Installation at Bonneville (Washington Shore Ladder)	Feb/01
Presentation of Prototype Results	Nov/01
Complete Production Installation at Bonneville (All Four Ladders)	Feb/02
Presentation of Production Results	Nov/02
Complete Design and Installation at The Dalles and John Day Projects	Feb/03
Presentation of Full District Implementation Results	Nov/03

3. Cost Estimate:

Activity	FY02	FY03	FY04	FY05	FY06
Prototype Evaluation	100				
Production Installation (Bonn)					
Plans and Specs	100				
Construction	1500				
Biological Evaluation	100	100			
Production Installation (The Dalles and John Day)					
Plans and Specs	200	100			
Construction		2000			
Biological Evaluation		200	200		
TOTALS	**2000**	**2400**	**200**		

4. **Issues:** Installation of adult PIT tag interrogation systems at The Dalles and John Day projects has not been coordinated or agreed to by regional stakeholders.

5. **RPA Action:** Biological Opinion measure Nos. 50 and 192. "The Corps and BPA shall install necessary adult PIT-tag detection at appropriate FCRPS projects before the expected return of adult salmon from the 2001 juvenile outmigration."

72. Bonneville Flow Deflectors

Multi-Year Plan

1. Project Information

- **Purpose/Objective** – The Bonneville spillway is made up of 18 bays. Spillway flow deflectors have been constructed within bays 4 to 15 and 18. These deflectors were designed for high involuntary spill flow events and may not provide optimum performance for the lower voluntary spill flows being required for juvenile fish passage.
- **Description –** Construct 5 spillway flow deflectors in bays 1, 2, 3, 16, 17 and 18; the existing deflector in bay 18 must be removed. These deflectors will be installed about 7 ft lower than where the existing deflectors are located. After installation of the new deflectors the Corps will conduct comparative tests to determine whether or not the new deflectors perform significantly better than the existing deflectors do. A decision document will be prepared to document the findings and to assist the region in deciding whether or not additional deflectors should be modified.

2. Major Activities/Tasks –

- Remove one existing deflector and replace with a new deflector.
- Install five additional new deflectors.
- Conduct both TDG tests and biological tests; comparative type tests between new deflectors and existing deflectors.
- Prepare a decision document with a recommendation regarding modification of existing deflectors.

Milestone	Date (Mo/Yr)
Initiate decision document	October 2003
Complete decision document	September 2004
Complete installation of 5 new and 1 modified deflectors	March 2002
Initiate Direct Mortality test using balloon tags and TDG tests	April 2002 and 2003

3. Cost Estimate -

Activity	FY02	FY03	FY04	FY05	FY06
	$8600,000	**$1500,000**	**$1000,000**	**TBD**	**TBD**

4. Issues –

- Modification of existing deflectors will not proceed until after biological and TDG tests have been conducted and the decision document has been completed.

5. RPA Action –

- 134; The Corps shall continue the spillway deflector optimization program.

73. The Dalles Flow Deflectors

Multi-Year Plan

1. **Project Information-** The Dalles spillway is made up of 23 bays; none of these bays have flow deflectors on them. The Corps will investigate the benefits and costs associated with installation of deflectors on The Dalles spillway to reduce Total Dissolved Gas (TDG).

- **Purpose/Objective** –Due to high levels of TDG that occurs during spill operations at The Dalles, it has been suggested by the region that the Corps investigate installation of flow deflectors on the spillway as a means for reducing the gas levels.

- **Description –** Through hydraulic studies at WES/ERDC using the general and sectional models, concurrent fish survival studies and prototype testing, the USACE is investigating modifications and/or additions to The Dalles dam which will increase fish survival. At this time, installation of deflectors on the spillway bays is being investigated as the most effective manner of reducing dissolved gas. Hydraulic information will also be provided in order to support the fish survival testing and Flow 3D/CFD modeling efforts which will address the mechanism of fish mortality at the dam.

2. **Major Activities/Tasks –**

Milestone	Date (Mo/Yr)
Complete 1:40 and 1:80 Model testing at ERDC	June 2002
Complete Design Documentation Report	January 03
Complete Plans and Specifications	June 03
Complete installation of 11 deflectors	April 04
TDG/biological testing and Interim spill patterns developed	April 04- August 04
Complete installation of 12 deflectors	April 05
TDG/biological testing and final spill patterns developed	April 05-July 05

3. **Cost Estimate** -

Activity	FY 01	FY02	FY03	FY04	FY05
	$400,000	**$1300,000**	**$2800,000**	**$5400,000**	**$7600,000**

4. **Issues** –
   - The above schedule is dependent on the completion of the modeling effort by April 02. This effort is subject to the availability of ERDC/WES facilities and personnel and the funding provided.
   - The incorporation of Fish Survival field studies information may lag the development of the Deflectors. Therefore, incorporation of changes may significantly change the above schedule.
   - Obtaining appropriate clearances to complete construction from September 1- April 15 of each construction season is needed.
   - Close coordination with the outfall program is anticipated; however, at this time, schedule impacts are not anticipated

5. **RPA Action** -
   - 134; The Corps shall continue the spillway deflector optimization program.

74. John Day Spill/Survival Studies

Multi-Year Plan

1. Project Information

- **Purpose/Objective** – Previous studies have indicated that 24-hour spill results in higher spill passage, and lower forebay retention time than 12-hour spill. Fish passage efficiency, however, has not been found to be different between 12 and 24-hour spill. The effect of 24-hour spill on passage distribution appears to be that fish normally guided into the juvenile bypass system at night are instead passed over the spillway during the day. Therefore, based on prior studies, it appears that the benefit of 24-hour spill is reduced forebay retention time.

  Further studies will be conducted to further assess the value of operational changes as they relate to spill. Additionally, if it is determined that benefits can be realized from a change in spillway operation the Corps, in coordination with BPA, will determine the impacts that will result to the hydropower system.

- **Description –**
  - A decision document will be prepared that weighs the benefits and costs/impacts of spill operational changes, the removable spillway weir, surface bypass through the skeleton bay(s) and extended-length screens. This decision document will consider impacts to navigation as well. Impacts to the hydropower system, including "lost revenue" will also be presented in the decision document.
  - The studies will identify juvenile salmonid response to daytime spill in terms of spillway passage, forebay residence time, and overall passage survival.
  - The studies will evaluate both spring and summer spill.
  - Adult passage considerations and potential adult fallback will be considered in the study design.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
Initiate FY 02 biological evaluation of 24-hour spill	April 2002
Complete report(s) for FY02 testing	December 2002
Initiate FY 03 biological evaluation of 24-hour spill	April 2003
Complete report(s) for FY 03 testing	December 2003
Initiate Decision Document (spill operation, surface bypass, screens, navigation)	October 2002
Complete Decision Document (spill operation, surface bypass, screens, navigation)	April 2004

3. Cost Estimate -

Activity	FY02	FY03	FY04	FY05	FY06
Biological Testing/Reports	2,000,000	2,100,000	550,000	0	0

4. Issues -

- A decision to change spill operation from 12 hours to 24 hours is dependent on the results of biological testing yet to be completed. A well thought out decision cannot be made until adequate biological data and economic data are developed; a change in operation of the magnitude being considered could have dramatic impacts to power generation.
- The costs (lost power) resulting from conducting the 24-hour spill tests is not included in the cost estimate.

5. RPA Action –

- 9; Annually develop 1 and 5 year plans for research, monitoring and evaluation.
- 71; Investigate 24-hour spill at John Day.
- 82; Investigate the spillway passage survival of juvenile salmonid.
- 83; Evaluate the effect of spill duration and volume on spillway effectiveness, spill efficiency, forebay residence time, and total project and system survival of juvenile steelhead and salmon.

75. John Day
Surface Bypass/Removable Spillway Weir/Flow Deflectors

Multi-Year Plan

1. Project Information

- **Purpose/Objective** – Investigate the benefits and costs of installing a removable spillway weir (RSW) and spillway flow deflectors at bays 1 and 20. The RSW installation and testing is intended to be a test of the skeleton bay surface bypass concept but could ultimately lead to a program where one or more RSW's are installed across the spillway in lieu of using the skeleton bays.

- **Description –**
  - Construction of flow deflectors in bay 1 and 20 will be completed by April 2002 along with a removable spillway weir for bay 20.
  - Biological tests will be conducted in 2002 and 2003 to evaluate the benefits or negative impacts of the removable spillway weir/surface bypass.

2. Major Activities/Tasks -

Milestone	Date (Mo/Yr)
Complete construction of flow deflectors (1&20) and RSW	March 2002
Initiate biological testing of RSW	April 2002
Complete biological testing of RSW	September 2002
Complete report on biological testing of RSW	December 2002

3. Cost Estimate -

Activity	FY02	FY03	FY04	FY05	FY06
	10130,000	**1500,000**	**TBD**	**TBD**	**TBD**

4. Issues –

- Funding required for FY 01 construction is not yet available and therefore the schedule is being jeopardized. The schedule will likely slip one year if funding ($500,000) is not available by July 15, 2001.
- Out year funding requirements for implementation of surface bypass will be estimated after a decision is made regarding implementation. Funding for extended-length screens has been included in the screen multi-year plan as a placeholder. Those funds could be used for surface bypass implementation rather than screens if the decision is made to proceed with installation of a surface bypass device at John Day.
- Portland District completed flow deflectors at bays 2 through 19 in April 1998 and subsequently new spill patterns were developed to improve passage conditions for both adult and juvenile salmonid. The change in spill patterns compromised conditions for downstream bound barges exiting the navigation lock. Video footage taken at John Day provides clear evidence that there is a strong lateral current coming off of the navigation lock guide wall traveling diagonally to the Washington shoreline. The condition is present at just about every flow condition but is exaggerated at higher river flows.

The field conditions could not been replicated in the model. Therefore new bathymetry was taken at the project and the model was surveyed. Differences between the field and the model were found and the model was modified to allow further evaluation. Further evaluation has been postponed, however, until deflectors are installed in bays 1 and 20 and a decision is made regarding surface bypass implementation.

- The impacts to navigation resulting from the installation of flow deflectors and the RSW will need to be evaluated and addressed. Estimates and schedules for addressing navigation issues are not included in the work plan. Issues regarding impacts to navigation will be evaluated as part of the John Day decision document included in the work plan for 24-hour spill versus 12-hour spill.

5. RPA Action –

- 134; The Corps shall continue the spillway deflector optimization program.
- 135; The Corps shall include evaluations of divider walls at each FCRPS project in the spillway deflector optimization program.
- 140; Design the spillway bay number 1 deflector and implement as warranted.
- 72; Continue design development of a prototype RSW and extended deflector for testing in 2002. Synthesize evaluation results, determine the fish survival benefits of one or more RSW's or a skeleton by surface bypass and install the units as warranted.
- 86; Continue to investigate a way to increase entry rates of fish approaching surface bypass entrances.
- 98; By January 2003, develop an analysis that compares the relative passage survival benefits of replacing existing standard-length intake screens with extended-length screens at the powerhouse to surface collection at one or more skeleton or spillway bays.
- 138; The Corps shall continue to investigate RSW's in conjunction with extended spillway deflectors, as a means of optimizing safe spillway passage.

78. COE to modify water supply to the Dworshak National Fish Hatchery for health and growth, while maintaining variable discharges of cold water from Dworshak to mitigate downstream temperatures [*Under Development*]

81. Columbia Basin Project Wasteway and Drain Investigation
Columbia Basin Project, Washington

2001, 2002

1. Project information

- **Purpose/Objective:** Reclamation will identify attraction problems with the wasteways and drains on the Columbia Basin Project and will work with NMFS to avoid or minimize such use, as warranted.

- **Description:** The December 2000 NMFS BiOp requires Reclamation to investigate the attraction of listed salmon and steelhead into wasteways and natural streams receiving waste water from the Columbia Basin Project.

2. Major Activities/Tasks: This activity is already in progress. Reclamation intends to complete this investigation by the fall of 2002.

Milestone	Date (Mo/Yr)
Completed site visit to wasteways ,drains and natural streams	3/01
Literature search and additional site survey	8/01
Survey for listed steelhead	2/02
Draft report to NMFS	6/02
Final report to NMFS	10/02

3. Cost Estimate: Funds would come from Reclamation appropriations.

Activity	FY02	FY03	FY04	FY05	FY06
Field surveys	TBD				
Draft report	TBD				
Final report	TBD				
TBD = to be determined					

4. Issues: Listed salmon and steelhead may be falsely attracted into the wasteways and natural

streams that receive project water and be lost to the population and the recovery effort of the species.

5. RPA Action: NMFS Action #37 - “BOR shall investigate the attraction of listed salmon and steelhead into wasteways and natural streams receiving waste water from the Columbia Basin Project. If listed fish are found to be attracted into these channels, BOR shall work with NMFS to identify and implement structural or operational measures to avoid or minimize such use, as warranted.

82. Burbank No. 2 and No. 3 Pumps
Columbia Basin Project, Washington

2001, 2002

1. Project information

- **Purpose/Objective:** Screen the Burbank No. 2 and No. 3 Pump Plant intakes for protection of juvenile salmon and steelhead and provide for juvenile fish egress. Provide and install fish screens on four small pumps (1-3 cfs) owned by McNary Wildlife Refuge.

- **Description:** Reclamation will design and construct pump intake fish screens and the four small scale fish screens to meet NMFS requirements and those of the NPPC Fish and Wildlife Program. Reclamation is working in conjunction with US Fish and Wildlife on connecting individual ponds within the Refuge to open up habitat for salmonids. The current McNary Wildlife Refuge Operating Plan provides egress from the Burbank No. 3 intake channel. Reclamation will operate existing facilities to provide egress from the Burbank No. 3 intake canal to the Burbank Slough.

2. Major Activities/Tasks: Design work is under way in 2001.

Milestone	Date (Mo/Yr)
Complete design work	5/01
Issue invitation for bids	06/01
Award construction contract	09/01
Complete construction	03/02

3. Cost Estimate: Funds would come from Reclamation appropriations.

Activity	FY01	FY02	FY03	FY04
Design and construct screens	$320,000	$460,000		

4. Issues: No major issues.

5. RPA Action: NMFS Action 38 – "By March 1, 2002, BOR shall install screens meeting NMFS' criteria at the canal intakes to the Burbank No. 2 and Burbank No. 3 pump. BOR shall connect the Burbank No. 3 intake canal to Burbank Slough to provide juvenile fish egress. . ."

83. Columbia River Return Water Quality Monitoring Plan
Columbia Basin Irrigation Project

Multi-year Plan: 2002-07

1. Project information

- **Purpose/Objective:** Characterize irrigation returns water quality and evaluate contaminants for potential impact on listed fish species.

- **Description:** The December 2000 NMFS BiOp requires Reclamation to monitor water quality for irrigation wasteway return flows to the Columbia River to assess potential adverse affects on listed species populations. We have identified 9 major project wasteway flow paths that account for 98% of total return flow to the river. Monitoring Program analytes include: dissolved ions, nutrients, fecal coliform, heavy metals, selected pesticides, and standard physical parameters (DO, pH, turbidity, suspended solids, and temperature). Sampling (periodicity, site selection, field equipment calibration, flow and continuous monitoring operation specifics) and data processing (evaluation, corrections, analysis, and toxicity evaluation) requirements have been identified. The water quality monitoring program will undergo yearly 'rolling' review to assess sampling frequency, analyte constituency, and budget adjustment needs. RPA may require post project activity (Abatement Plan) if toxicity potential exists in project wasteways.

2. Major Activities/Tasks: Project activities in progress. Define project goals and objectives and identify data quality objectives. Assess return flow data history and equipment needs. Characterize and document sampling sites, select analytes and sampling frequency, schedule sampling and calibration activities, develop QA/QC protocols, and determine sampling regime representativeness. Develop initial plan and budget needs, with periodic internal and external quality review. Collect and analyze water quality data, evaluate toxicity potentials, prepare and distribute project products.

Milestone	Date (Mo/Yr)
Develop water quality program plan, oral presentation to NMFS	06/2001
Collect water quality data	03/02-10/07
Conduct yearly rolling reviews and prepare annual, final reports	10/02-10/07
Analyze data products and evaluate analyte toxicity potential	10/04-10/07
Program review and final product(s) preparation and dissemination	03/07-12/07

3. Annual Cost Estimates: Funded with Reclamation appropriations.

Activity	FY 01	FY02	FY03	FY04	FY05	FY06
Development/Review and ancillary costs	$20,000	$3,000	$4,000	$3,000	$2,000	$4,000
*Analyte Sampling	$8,000	$30,000	$40,000	$40,000	$35,000	$30,000
*Analysis/*Products		$10,000	$10,000	$15,000		
Equipment/Supplies	$18,000	$3,000	$14,000	$3,000	$3,000	$2,000
* Technical Support		0	$5,000	$5,000	$8,000	$10,000

Symbol designation, * potential cost share with CBIP Irrigation Districts

4. Issues: RPA (#39) narrative requires cooperative plan development and interpretation. TMDL initiatives for several wasteways requires additional monitoring activities (cooperative work with CBIP District personnel). Additional aquatic pesticide monitoring activities due to recent Circuit Court decision (cooperative activity with District personnel). NMFS contact indicated that extended monitoring may be required (Mark Schneider, phone discussion of initial plan contents, 03/01).

5. RPA Action: RPA #39. BOR must evaluate the water quality characteristics of each point of surface return flows from the Columbia Basin Project to the Columbia River and estimate the effects these return flows may have on listed fish in the Columbia River and wasteways accessible to listed fish. By June 1, 2001, BOR must provide NMFS with a detailed water quality monitoring plan, including a list of water quality parameters to be evaluated. If the water quality sampling reveals enough water quality degradation to adversely affect listed fish, BOR shall develop and initiate implementation of a wasteway water quality remediation plan within 12 months of the completion of the monitoring program.

84. Investigate surface bypass RWSW at McNary Dam and install the unit in multiple spillways as warranted [*Under Development*]

85. Investigate surface bypass RWSW at Lower Monumental Dam and install the unit in multiple spillways as warranted [*Under Development*]

86. State-of-the-art turbine design technology at The Dalles and Ice Harbor [*Under Development*]

87. Management of Predacious Fishes to Increase Juvenile Survival

DRAFT Multi-Year Plan

1. Project Information

- **Purpose/Objective:** To reduce the losses of juvenile salmonids to northern pikeminnow predation and other predatory fishes, and to develop a more comprehensive strategy of habitat improvements, hydrosystem operations, and fisheries to enhance function of ecological communities as a means to increase survival of outmigrating juvenile salmonids.

- **Description:** Northern pikeminnow, smallmouth bass, channel catfish, and walleye are important predators of juvenile salmon. Various studies conducted in the 1980's indicated that northern pikeminnow predation in the John Day reservoir alone consumed between 1.4 and 3.3 million juvenile salmonids each year. Predator control efforts to date have focused on removing northern pikeminnow from the Snake and Columbia rivers and evaluating the behavior and distribution of predators in the near-dam and reservoir reaches. Additional emphasis should be placed on other predatory species in areas where those species cause significant losses of juvenile salmonids.

  Introduced fish species into areas of favorable habitat tend to outcompete native fishes. Bass, walleye, and channel catfish are of particular concern.

2. Major Activities/Tasks: Implementation of the Northern Pikeminnow Management Program would continue, generally as it has been implemented in recent years. The Action Agencies

Milestone(10pt)	**Date (Mo/Yr)**
Continue Implementing NPMP	2002 →
Develop concept to enhance ecological community function	2001
Initiate pilot study	2001/2003

3. Cost Estimate:

Activity	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**
NPMP	2,800,000	2,800,000	2,900,000	3,000,000	

4. Issues: Resident fishes are managed by state fish and wildlife agencies for sport fisheries. Regional agreement to reduce the numbers of non-indigenous species to benefit native species has not been achieved. Concept of more holistic approach of enhancing function of ecological communities to reduce predation has not been validated.

5. RPA Action:

Action 100: The Action Agencies shall continue to implement and study methods to reduce the loss of juvenile salmonids to predacious fishers in the lower Columbia and Snake rivers. This effort will include the continuation and improvement of the ongoing Northern Pikeminnow Management Program and evaluation of methods to control predation of non-indigenous predacious fishes, including smallmouth bass, walleye, and channel catfish.

Action 105: The Action Agencies shall develop a pilot study to assess the feasibility of enhancing the function of ecological communities to reduce predation losses and increase survival in reservoirs and the estuary.

88. COE to develop and construct spillway deflectors at Chief Joseph Dam to minimize TDG [*Under Development*]

89. COE to investigate TDG abatement at Libby Dam, including the installation of spillway deflectors and/or additional turbines [*Under Development*]

III. Water Management

Overview

Water management operations impact the ESU's in the following ways: (1) water is released as spill at the downstream run-of-river dams to enhance juvenile passage; (2) water is released from the storage reservoirs to provide migration flows; (3) water is released to maintain water over spawning beds in the mainstem Columbia; (4) water is released to maintain minimum daily flows required by Bull Trout and White Sturgeon; and (5) water is released to enhance water quality.

A Technical Management Team (TMT) makes seasonal water management decisions. Open meetings typically attended by federal and state representatives meet weekly to weigh water management options, benefits, and trade-offs. Consensus recommendations, if reached, are forwarded to federal agency decision-makers. Policy matters may be referred to the Implementation Team (IT) for further deliberation. One value of TMT and IT is to inform decision-makers of differing views and potential impacts of water management actions even if consensus can not be reached on any particular action.

Variations in climate can lead to certain years with low water and even drought conditions. The NMFS BiOp anticipates these variations by seeking performance standards over a 10-year period. Section 9.6.1.2.3 of the BiOp outlines provisions for weighing considerations unique to each particular year. Provisions for dealing with power system emergencies are described, including provisions for the involvement of regional executives, when emergencies of exceptional magnitude or duration occur.

Water management actions seek to utilize storage reservoirs to provide increased flows in spring, reflecting the natural hydrograph of s spring runoff from snowmelt. The majority of juveniles migrate through the hydro system in the spring and their passage is enhanced by increased spring flows. Summer flows aid summer juvenile migrants from the Upper Columbia and Snake River. Summer flows from deep reservoirs like Dworshak provides cool water to reduce temperatures, which can be harmful to both migrating juveniles and adults. Fall and winter flows provide important habitat for mainstem spawning chum and fall Chinook.

Specific water management actions vary seasonally according to specific species harboring the FCRPS at different times of year. The action agencies must manage a varying amount the available water from precipitation and snow-pack. The five-year water management plan addresses actions requiring several tears to implement, such as those requiring studies, NEPA and NHPA compliance. Each year, the annual water management plan requires in-season adjustments reflecting actual amount of water available.

Five-Year Water Management Plan

Many water management actions that will take several years to implement are termed 5-Year Water Management Projects. Detailed Project Management Plans (like those provided for configuration projects) are enclosed at the end of this discussion .

Environmental Impact Statements are currently being prepared for several of these actions. The environmental process together with both the Regional Forums (IT and TMT) requests for comment on this Implementation Plan provide States, local governments, stakeholders, and the public will have an opportunity for involvement in these processes to inform site-specific implementation decisions. Tribal governments have an opportunity to consult the action agencies regarding potential impacts on Tribal resources, including traditional cultural resources.

Project Management Plans

Project Management plans for long-term water management project and programs are enclosed as the following pages:

65. Reclamation Project Water Conservation Improvements
Pacific NW Region-wide

Multi-year Plan

1. Project information

- **Purpose/Objective:** The overall purpose/objective for this program is to encourage water conservation in irrigation districts. An ESA emphasis for this project will help to develop mechanisms to put more water in the mainstem Columbia River during the juvenile salmon migration season (April through August).

- **Description:** Reclamation has an existing water conservation staff dedicated to promoting the efficient use of water. Efficient use of water has many potential benefits, including reduced energy requirements (for pumping), improved water quality (through reductions in soil erosion and reduced leaching of chemicals and nutrients), and improved streamflows, particularly near the location of the conservation improvements. In this regard it should be noted that some Reclamation projects are located in the migration corridor of NMFS listed fish, while other projects are far upstream of the migration corridor. Conservation induced increases in streamflows that occur at a diversion location may disappear as diverters located down-gradient exercise their lawful rights to water. On the other hand, when water conservation mechanisms are in place and water is managed more efficiently more water is potentially left in storage increasing the probability of a reservoir to fill (and spill) the following year. This also increases the probability for more water to be put in water banks for leasing for salmon migration flow augmentation or instream uses. This water may offer opportunities to alter reservoir management to improve streamflows. Water conservation will not significantly alter depletions to the Columbia River.

2. Major Activities/Tasks:

Milestone	Date (Mo/Yr)
Develop revised project selection criteria to increase emphasis on improving instream flows	2002

3. Cost Estimate: Program is funding through Reclamation appropriations.

Activity	FY02	FY03	FY04	FY05	FY06
Water Conservation Field Services Program	$539,000	TBD	TBD	TBD	TBD
TBD = to be determined					

4. Issues: As indicated above, water conservation actions are not equally beneficial to listed species. In addition, the "available mechanisms" vary from state to state, and situation to situation. Project authorizations and contracts may further limit transfer potential. Reclamation will evaluate prospective water conservation activities from the perspective of benefits to listed species.

5. RPA Action: Action 28 calls on the Bureau of Reclamation to pursue water conservation at its projects and use all available mechanisms to ensure that a "reasonable portion" of the water conserved benefits listed species.

66. Report on Unauthorized Use of Reclamation Water
Pacific NW Region-wide

Multi-year project

1. Project information

- **Purpose/Objective:** The ESA purpose of this project is intended to put more water in the mainstem Columbia River during the juvenile salmon migration season (April through August).

- **Description:** This action item recognizes that the unauthorized uses of Reclamation supplied water are activities neither authorized, funded, nor carried out by Reclamation. Resolving these situations often prove to be complex and require significant time and staff resources to resolve. In accordance with this action item, Reclamation will provide NMFS a detailed progress report of its activities in this area by December 21, 2002.

2. Major Activities/Tasks: As part of its ongoing activities in water rights adjudications and other arenas, Reclamation continues to address the "unauthorized use" of project water on a case-by-case basis.

Milestone	Date (Mo/Yr)
Case-by-case review of use of project water	ongoing
Detailed progress report to NMFS	12/02

3. Cost Estimate: This is funded by Reclamation appropriation.

Activity	FY02	FY03	FY04	FY05	FY06
Progress report	$25,000				

4. Issues: Some solutions to unauthorized use may not result in the opportunity to add water to the mainstem Columbia (e.g., boundary adjustments and land re-classification).

5. RPA Action: NMFS action 29 – "Within 2 years from the date this opinion, BOR shall provide NMFS with a detailed progress report addressing possible instances where BOR-supplied water within the Columbia River is being used without apparent BOR authorization to irrigate lands. . . . "

67. Water Acquisition from
Reclamation's Upper Snake River Basin Projects
Multi-year Plan

1. Project information

- **Purpose/Objective:** This project is intended to develop mechanisms to put more water in the mainstem Columbia River during the juvenile salmon migration season (April through August).

- **Description:** This action item calls on Reclamation to continue and extend efforts that have been ongoing since 1993 – the acquisition of water from willing sellers to augment Snake River flows. Inherent in this activity is accomplishing willing seller acquisitions in accordance with state water law. Reclamation and NMFS are presently in active discussions about flow augmentation needs with the state of Idaho and Idaho water users, and Reclamation continues to explore opportunities to acquire additional supplies. A key process for long-term accomplishment is the successful completion of the Nez Perce settlement discussions under the Snake River Basin Adjudication.

2. Major Activities/Tasks: Reclamation would continue to acquire water rights through annual rentals, long-term leases, and permanent acquisitions from willing sellers.

Milestones	Date (Mo/Yr)
Complete Nez Perce settlement discussions	2001
ESA consultation on Nez Perce settlement	2001
Interim authorizing legislation from State of Idaho	2002
Programmatic NEPA on Nez Perce settlement	TBD
Long-term federal and state authorization	TBD

3. Cost Estimate: This is funded by Reclamation appropriations.

Activity	FY02	FY03	FY04	FY05	FY06
Water acquisitions	$2.4 m	TBD	TBD	TBD	TBD
TBD = to be determined					

4. Issues: There is a great deal of uncertainty of the outcome of the Nez Perce settlement discussions. Timing of delivery of Reclamation-acquired water is somewhat dependent on outcome of separate ESA consultation with Idaho Power Company and FERC on the operation of the IPC Hells Canyon Complex.

5. RPA Action: NMFS Action 32 – "The action agencies shall acquire water for instream use from BOR's Upper Snake River basin projects and Idaho Power Company's Hells Canyon Complex during the spring and summer flow augmentation periods to improve the likelihood of achieving spring and summer flow objectives at Lower Granite Dam."

68. Banks Lake Drawdown Study
Columbia Basin Project, Washington

2001, 2002

1. Project information

- **Purpose/Objective:** This project is intended provide more water in the mainstem Columbia River during the summer juvenile salmon migration season (July through August).

- **Description:** The Banks Lake Drawdown study will examine the effects of an additional 5' reduction in the surface elevation of the reservoir during the month of August. This would reduce the amount of water pumped into Banks Lake by about 130 kaf, which could effectively increase the amount of Columbia River water available for flow augmentation. The lake already operates in its top 5 feet (elevation 1570 to 1565 feet) to help increase Columbia River flows.

  Among the potential effects anticipated are those on the aquatic vegetation, resident fish, cultural resources, recreation, and shoreline erosion of Banks Lake. Power impacts will be examined including impacts on FCRPS power production, both on the Columbia River and at the pump-generation plant. There will also be an analysis of effects to the power plants in the irrigation system and water supply the irrigators in the Columbia Basin Project.

2. Major Activities/Tasks: This will be a NEPA analysis.

Milestone	Date (Mo/Yr)
Notice to Federal Register	04/01
Scoping meeting(s)	05/01
Complete review of internal Draft EIS	10/01
Draft FWCA Report from USFWS	10/01
Publish Draft EIS	12/01
Close of public comment period	02/02
Final FWCA Report from USFWS	04/02
Issue Final EIS	05/02
Issue Record of Decision	06/02

3. Cost Estimate: This is funded by Reclamation appropriations for 2001 which can be obligated for

use in FY2001 and FY2002.

Activity	FY02	FY03	FY04	FY05	FY06
Prepare EIS	$350,000				

4. Issues: The main issue will be the anticipated effects on recreation and associated impacts on the local economy and exposure of cultural resources during the period of the year when the largest number of people are using the Banks Lake area.

5. RPA Action: NMFS Action 31 – "BOR shall assess the likely environmental impacts of operating Banks Lake up to 10 feet down from full pool in August. The assessment and NEPA compliance work shall be completed by June 2002 to determine future operations at this project by the summer of 2002."

69. Libby VARQ Implementation

Multi-Year Plan
April 2001

1. Project Information

Purpose/Objective -The purpose of VARQ is to provide better assurance of refilling Libby and Hungry Horse Reservoirs while meeting flow needs for sturgeon, bull trout, salmon and steelhead. VARQ provides for reduced drafting in many water years, especially low and medium runoff forecast years, while assuring local flood control needs are met. By reducing flood storage volume in late winter, additional water is provided for downstream flows needed for sturgeon spawning in the Kootenai. This additional water from both projects also benefits a number of listed salmon and steelhead stocks in the middle and lower Columbia. because of spring outflow and because of greater availability of water from Libby in summer.

Description - Existing flood control operations are conservative, drafting more than necessary for local flood control in the Kootenai and Flathead systems. Furthermore, there is evidence that system flood control needs to be reexamined to see if it could also be provided in a less conservative manner. Water that is released in winter for flood control could provide benefits for fisheries and other ecosystem needs, as well as for recreation, if it were stored instead. Montana's Integrated Rule Curves, and the succeeding and related VARQ operation, address this need by varying the rule curves for Libby and Hungry Horse according to runoff forecast. Thus, in years with lower and medium runoff forecasts, less drafting is required than at present. The USFWS and NMFS have called for VARQ implementation in the 2001 BiOps (see below). NEPA documentation prior to implementation of VARQ must address issues not fully evaluated under SOR, including transboundary issues, issues surrounding Lake Roosevelt drafting, system flood control, and controversy in the Kootenai basin. Further studies are needed on some items. This action requires an EIS; it does not lend itself to an EA/FONSI.

2. Major Activities/Tasks – In FY 2001, the emphasis will be on scoping and initiation of hydrologic/flood control studies. Those studies will continue into FY 2002. NMFS and FWS have been requesting implementation of VARQ for several years. However, the Corps has never been able to fund the work. Though funding is now being made available, the necessary hydrologic studies will require at least until FY02 to complete, and fisheries and other impact analyses will extend the effort some time beyond that. For instance, a spill test at Libby Dam is required to assure safe use of the spillway during VARQ flows. Preparation of study reports and a draft EIS, followed by required internal and public reviews and finalization, make completion of the final EIS unlikely to occur before 2004.

Milestone	Date (Mo/Yr)
EIS effort funded	5/01
Initiate scoping	6/01
Initiate hydrologic/flood control evaluations	5/01
Finish hydrologic/flood control evaluations	9/02
Initiate fisheries studies	12/01
Finish fisheries studies	9/02
Initiate other studies	8/02
Finish other studies	12/02
NEPA documentation complete	6/04
Implement VARQ	1/05

3. Cost Estimate – The following is obviously very tentative; estimates and timelines are still being assembled.

FY01	FY02	FY03	FY04	FY05
$438,169	$988,609	$505,944	$394,430	

4. Issues –The USFWS timeline is not going to be met by this schedule. Though the schedule was not known in detail during consultation, that fact was discussed in consultation and resulted in a jeopardy opinion for sturgeon from the USFWS. Otherwise, there are a number of scoping issues known at the outset. To date, the following issues of concern have been identified to be analyzed in depth in the draft EIS: (1) flood control impacts on a local and a systemwide basis; (2) fisheries and other aquatic ecosystem impacts and benefits in affected reservoirs and downstream in the Kootenai and Flathead systems and on the mainstem Columbia; (3) effects of potential increase in frequency of spill and impacts from dissolved gas on aquatic organisms; (4) groundwater seepage in lands from prolonged high spring flows along the Kootenai River in Idaho; (5) levee integrity concerns from prolonged high spring flows along the Kootenai River in Idaho and British Columbia; (6) potential for increased suspension of sediments due to drawdown of Lake Roosevelt (Grand Coulee); (7) potential aerial transport of contaminants (mainly heavy metals) from exposed Lake Roosevelt sediments; (8) exposure, looting and vandalism of prehistoric artifacts and human remains along Lake Roosevelt; (9) recreational impacts on affected reservoirs; (10) Columbia system power generation impacts; and (11) power generation impacts at Canadian projects downstream of Libby Dam, a treaty issue. There are fish stocks listed under ESA that would be directly affected by the proposed action, including Kootenai River white sturgeon (endangered), bull trout (*Salvelinus confluentus*) (threatened); various stocks of chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*) and sockeye (*O. nerka*) salmon, and steelhead (*O. mykiss*).

5. RPM Action –

USFWS BiOp:
RPM 8.1.b. By January 2001, the action agencies shall develop a schedule of all disclosures, NEPA compliance and additional Canadian coordination necessary to implement VARQ flood control/storage at Libby Dam. The action agencies shall complete coordination with Canada and NEPA compliance, and implement VARQ by October 2001.

RPM 8.1.d. Beginning October 2001, the action agencies shall store water under VARQ and supply, at a minimum, water volumes during May, June and July based upon a water availability or "tiered" approach as modified from the final Sturgeon Recovery Plan and summarized in Table 10 of the BO. This shall be in addition to storage needs for listed bull trout, salmon, and the 4,000 cfs minimum releases from Libby Dam. Accounting on these total tiered volumes shall begin when the Service determines benefits to conservation of sturgeon are most likely to occur. This may include releases timed to enhance survival of eggs, yolk sac larvae, or larvae reared under the preservation stocking program and released into the Kootenai River. Releases may be timed to serve both wild fish and hatchery eggs/fish. Sturgeon flows will generally be initiated between mid-May and the end of June to augment lower basin runoff entering the Kootenai River below Libby Dam.

NMFS BiOp
RPMs, Hydro Action 19 - The Corps and BOR shall implement VARQ flood control operations, as defined by the Corps (1999d), at Libby by October 1, 2001, and at Hungry Horse by January 1, 2001. By February 1, 2001, the Corps shall develop a schedule to complete all disclosures, NEPA compliance, and Canadian coordination necessary to implement VARQ flood control at Libby.

76. Reclamation Water Contracts
PN Region-wide

Multi-year Plan

1. Project information

- **Purpose/Objective:** The ESA purpose of this action is to increase the frequency of achieving flow objectives in the Columbia River.

- **Description:** Under Reclamation law, Reclamation enters into contracts with irrigation districts, individuals, and municipalities for water supplies from federal projects. With few exceptions, Reclamation has used repayment contracts to formalize agreements between the United States and water users. Repayment contracts are long-term contracts having no expiration dates or renewal provisions. In return for the water supply benefits received from the federal projects, the water users repay the capital and operation and maintenance costs associated with the project facilities. The exceptions, for the most part, are contracts for the use of irrigation water from Corps of Engineers reservoirs and more recent municipal and industrial contracts. For these contracts, water service contracts have been utilized. The majority of these contracts are 40-year contracts with provisions for renewal. Any contract renewal or contract modification to increase the acreage served would require consultation with NMFS per this action.

2. Major Activities/Tasks: There are no major Reclamation project consultations currently scheduled for contract actions. Reclamation will consult on the renewal of the water service contracts for Lucky Peak Dam and Reservoir, a Corps project on the Boise River. Additionally, consultations are taking place on the operations and maintenance of the Corps' Willamette Basin Projects, which includes water service contracts administered by Reclamation.

Milestone	Date (Mo/Yr)
Lucky Peak contract renewals (Corps project)	2004

3. Cost Estimate: This will be funded with Reclamation appropriations.

Activity	FY02	FY03	FY04	FY05	FY06
Lucky Peak contract renewals	TBD	TBD	TBD	TBD	TBD
TBD = to be					

determined					

4. Issues: There will likely be competing demands for the water and reservoir space being considered in any contracting action and consultation.

5. RPA Action: NMFS Action 27 – "Before entering into any agreement to commit currently uncontracted water or storage space in any of its reservoirs covered by this biological opinion to any other use that salmon flow augmentation, BOR shall consult with NMFS . . . . Also, BOR shall consult with NMFS before entering into any new contract or contract amendment to increase the authorized acreage served by any irrigation district receiving BOR-supplied water. . ."

77(a). Deschutes River Projects ESA Consultation
Crooked River, Deschutes, and Arnold Projects, Oregon

2001, 2002

1. Project information

- **Purpose/Objective:** Reclamation will complete ESA Section 7 consultation on the operation and maintenance of its projects in the Deschutes River Basin.

- **Description:** The focus of the BA will be Reclamation's hydrologic operations and maintenance (O&M) program in the Deschutes River basin and the effects on listed species, species proposed for listing under ESA, and candidate species. The BA will cover specific river, tributary, and reservoir reaches in the Deschutes River basin from headwaters reservoirs to the Deschutes River's confluence with the Columbia River.

  All facilities associated with Federal projects located in the Deschutes River basin will be included in this BA. This includes at least three Federal reclamation projects (and possibly a fourth, the Wapinitia Project, depending on a determination of what Federal discretion remains). There are five (or six) major storage reservoirs associated with these projects. Irrigation deliveries are made from in these storage reservoirs. Actual day-to-day operations are conducted by the respective irrigation districts under contract with Reclamation.

2. Major Activities/Tasks: This activity is already in progress. Reclamation intends to follow necessary procedures to perform Section 7 consultation.

Milestone	Date (Mo/Yr)
Complete operations description	05/01
Submit draft BA to NMFS and USFWS	05/01
Submit final BA to NMFS and USFWS	07/01
Receive draft BiOp from NMFS	09/01
Receive final BiOp from NMFS	01/02
Complete Record of Decision	03/02

3. Cost Estimate: Funds would come from Reclamation appropriations.

Activity	FY02	FY03	FY04	FY05	FY06
Complete BA	TBD				
Comment on draft BiOp	TBD				
Prepare ROD	TBD				
TBD = to be determined					

4. Issues: The proposed action describes only the Reclamation actions of water storage and release from our reservoirs and the delivery of water to our contractors. Irrigation districts may want to include non-federal actions which would require up front agreement before completing preparation of the BA.

5. RPA Action: NMFS Action 30 – "For those BOR projects located in the Columbia River and its tributaries downstream from Chief Joseph Dam . . ., BOR shall, as appropriate, work with NMFS in a timely manner to complete supplemental, project-specific consultations."

77(b). Yakima Project ESA Consultation
Yakima Project, Washington

2001, 2002

1. Project information

- **Purpose/Objective:** Reclamation will complete ESA Section 7 consultation on the operation and maintenance of its projects in the Yakima River Basin.

- **Description:** The December 2000 NMFS BiOp requires Reclamation to consult on the operations of its projects below Chief Joseph Dam on the Columbia River. The Yakima Irrigation Project, located in the Yakima River basin in south central Washington, includes 6 storage reservoirs in the upper end of the basin. These are Rimrock Reservoir, Clear Lake, and Bumping Lake on the Naches River arm of the basin and Cle Elum Reservoir, Kachess Reservoir and Keechelus Reservoir on the upper mainstem of the Yakima River. Cle Elum Reservoir was the last facility built and it was completed in 1933. Combined these reservoirs have a storage capacity of 1,070,700 acre-feet. The project also includes 5 diversion dams on the mainstem of the Yakima and Tieton rivers. These stretch from the Lake Easton Diversion Dam at river mile (RM) 202.5 to the Prosser Diversion Dam at RM 47.1. There are about 500,00 irrigated acres in the project area and average annual demand is about 2.5 million acre-feet. The project includes two small powerplants, the Roza Powerplant, located on the Roza Canal at approximately RM 113.3, and the Chandler Powerplant, located on the Chandler Canal at RM 35.8.

2. Major Activities/Tasks: This activity is already in progress. Reclamation intends to follow necessary procedures to perform Section 7 consultation.

Milestone	Date (Mo/Yr)
Submit BA to NMFS and USFWS	8/00
Receive draft BiOp from NMFS	08/01
Receive final BiOp from NMFS	01/02
Complete Record of Decision	03/02

3. Cost Estimate: Funds would come from Reclamation appropriations.

Activity	FY02	FY03	FY04	FY05	FY06
Complete BA					
Comment on draft BiOp	TBD				
Prepare ROD	TBD				
TBD = to be determined					

4. Issues: The proposed action describes only the Reclamation actions of water storage and release from our reservoirs and the delivery of water to our contractors. It also addresses the operation and maintenance of federally constructed and owned irrigation facilities and fish protection facilities. Some may take issue with the on-farm practices with respect to contractors' use of project water.

5. RPA Action: NMFS Action 30 – "For those BOR projects located in the Columbia River and its tributaries downstream from Chief Joseph Dam . . ., BOR shall, as appropriate, work with NMFS in a timely manner to complete supplemental, project-specific consultations."

77(c). Umatilla Project ESA Consultation
Umatilla Project, Oregon

2001, 2002

1. Project information

- **Purpose/Objective:** Reclamation will complete ESA Section 7 consultation on the operation and maintenance of its project in the Umatilla River Basin.

- **Description:** The December 2000 NMFS BiOp requires Reclamation to consult on the operations of its projects below Chief Joseph Dam on the Columbia River. The Umatilla Project is located in the Umatilla River basin in north central Oregon. Umatilla Project facilities include McKay Dam and Reservoir on McKay Creek and Cold Springs Reservoir, an off-stream storage facility. There are four irrigation districts in the basin which receive water from the Project. Two of those districts operate and maintain Federal irrigation facilities while the other two operate private facilities. All of the diversions facilities are screened and passage is provided at all of the diversion dams. Three districts take part in the Columbia River exchange program whereby diversions from the Umatilla River are foregone in exchange for water diverted from the Columbia River. The Project currently irrigates 43,300 acres with an average annual demand of about 192,600 acre-feet.

2. Major Activities/Tasks: This activity is already in progress. Reclamation intends to follow necessary procedures to perform Section 7 consultation.

Milestone	Date (Mo/Yr)
Submit BA to NMFS and USFWS	01/01
Receive draft BiOp from NMFS	09/01
Receive final BiOp from NMFS	01/02
Complete Record of Decision	03/02

3. Cost Estimate: Funds would come from Reclamation appropriations.

Activity	FY02	FY03	FY04	FY05	FY06
Complete BA					
Comment on draft BiOp	TBD				
Prepare ROD	TBD				
TBD = to be determined					

4. Issues: The proposed action describes Reclamation actions of water storage and release from our reservoirs and the delivery of water to our contractors. It also addresses the operation and maintenance of federally constructed and owned irrigation facilities and fish protection facilities. Some may take issue with the on-farm practices with respect to contractors' use of project water.

5. RPA Action: NMFS Action 30 – "For those BOR projects located in the Columbia River and its tributaries downstream from Chief Joseph Dam . . ., BOR shall, as appropriate, work with NMFS in a timely manner to complete supplemental, project-specific consultations."

77(d). Okanogan Project ESA Consultation
Okanogan Project, Washington

2003, 2004

1. Project information

- **Purpose/Objective:** Reclamation will complete ESA Section 7 consultation on a feasibility study to study "opportunities to better manage the water resources in the Salmon Creek watershed..." The purpose of the study is "to derive the benefits of and further the objectives of the comprehensive, independent study commissioned by the Confederated Tribes of the Colville Reservation and the Okanogan Irrigation District, which provides a credible basis for pursuing a course of action to simultaneously achieve fish restoration and improved irrigation conservation and efficiency."

- **Description:** The December 2000 NMFS BiOp requires Reclamation to consult on the operations of its projects below Chief Joseph Dam on the Columbia River. The Okanogan Irrigation Project uses between 11,000 and 21,000 acre-feet annually from two storage reservoirs to irrigate 5,032 acres of orchard crops, alfalfa, and pasture. The storage reservoirs are both on Salmon Creek, a tributary to the Okanogan River. Salmon Lake Dam (upper dam) impounds Conconully Lake (upper reservoir) and Conconully Dam (lower dam) impounds Conconully Reservoir (lower reservoir). Water is diverted from Salmon Creek Diversion Dam located about 11 miles below the storage reservoirs and delivered through carriage facilities operated by the Okanogan Irrigation District.

2. Major Activities/Tasks: This activity is already in progress. Reclamation intends to follow necessary procedures to perform Section 7 consultation.

Milestone	Date (Mo/Yr)
Submit BA to NMFS and USFWS as part of Feasibility Study	FY03
Receive draft BiOp from NMFS	FY03
Receive final BiOp from NMFS	FY04
Complete Record of Decision	FY04

3. Cost Estimate: Funds would come from Reclamation appropriations.

Activity	FY02	FY03	FY04	FY05	FY06
Complete BA		TBD			
Comment on draft BiOp		TBD			
Prepare ROD			TBD		

4. Issues: Consultation will be done as part of consultation on the Congressionally authorized feasibility study for Salmon Creek. The No Action alternative would be continuation of the current operations and will be part of the analysis. If the No Action alternative would result in jeopardy or incidental take of listed stocks the other identified alternatives would provide either RPA's or RPM's for the existing operation..

5. RPA Action: NMFS Action 30 – "For those BOR projects located in the Columbia River and its tributaries downstream from Chief Joseph Dam . . ., BOR shall, as appropriate, work with NMFS in a timely manner to complete supplemental, project-specific consultations."

77(e). Chief Joseph Project ESA Consultation
Chief Joseph Project, Washington

2001

1. Project information

- **Purpose/Objective:** Reclamation will complete ESA Section 7 compliance on the operation and maintenance on the units of the Chief Joseph Project.

- **Description:** The December 2000 NMFS BiOp requires Reclamation to consult on the operations of its projects below Chief Joseph Dam on the Columbia River. The Chief Joseph Project consists of several small irrigation units located along the Columbia River below Chief Joseph Dam. These include the Brewster Flats project near Brewster, Washington, the Bridgeport Bar unit near Bridgeport, Washington and the East Unit near East Wenatchee. All three of these units maintain pumping stations along the Columbia River. In 1997 and 1998 the screen on the East Unit and Brewster Flat pumping station were replaced to bring them into compliance with NMFS screening criteria and NMFS was consulted with at that time. The infiltration gallery at Bridgeport Bar was also examined and determined to be functioning properly to protect fish. All three of these units deliver water through pressurized pipe systems and there is no surface water return flow to the Columbia River.

2. Major Activities/Tasks: The fish protection facilities at the pumping stations for the three units of the Chief Joseph Project on the Columbia River have recently been inspected and upgraded where necessary to provided fish protection. The water diversions for these projects have been analyzed as part of the FCRPS consultation process. Since there are no on district impacts since the systems are all enclosed, pressurized pipelines and there are no return flows to the Columbia River there are no additional operational issues that might affect listed species. As a result additional consultations not envisioned.

3. Cost Estimate: Work has already been completed..

4. Issues: Actions covered to date include fish protection facilities at the points of diversion and impacts of diversions on the Columbia River. Impacts from operation and maintenance activities have not been identified as the systems are all enclosed, pressurized pipelines and there are no return flows to the Columbia River. Some may take issue with the on-farm practices with respect to contractors' use of project water.

5. RPA Action: NMFS Action 30 – "For those BOR projects located in the Columbia River and its tributaries downstream from Chief Joseph Dam . . ., BOR shall, as appropriate, work with NMFS in a timely manner to complete supplemental, project-specific consultations."

77(f). Tualatin River Projects ESA Consultation
Tualatin Project, Oregon

2001, 2002

1. Project information

- **Purpose/Objective:** Reclamation will complete ESA Section 7 consultation on the operation and maintenance of its projects in the Tualatin River Basin.

- **Description:** The Tualatin Project area lies primarily in Washington County in the northwest part of the Willamette Basin, west of and adjacent to the city of Portland, Oregon. Some 17,000 acres of land are furnished irrigation water. Several communities and an industrial corporation are furnished untreated water for municipal and industrial use, and for quality control purposes. Fish and wildlife enhancement, recreation, and flood control are also important project functions.

  Principal features include Scoggins Dam (53,600 af), Henry Hagg Lake, Patton Valley Pumping Plant, Spring Hill Pumping Plant, booster pumping plants, and piped lateral distribution systems.

  The focus of the BA will be Reclamation's hydrologic operations and maintenance (O&M) program in the Tualatin River basin and the effects on listed species, species proposed for listing under ESA, and candidate species.

2. Major Activities/Tasks: This activity is already in progress. Reclamation intends to follow necessary procedures to perform Section 7 consultation.

Milestone	Date (Mo/Yr)
Prepare draft O&M description	07/01
Submit final BA to NMFS and USFWS	09/01
Receive final BiOp from NMFS	12/02
Complete Record of Decision	02/02

3. Cost Estimate: Funds would come from Reclamation appropriations.

Activity	FY02	FY03	FY04	FY05	FY06
Complete BA	TBD				
Comment on draft BiOp	TBD				
Prepare ROD	TBD				
TBD = to be determined					

4. Issues: The proposed action describes only the Reclamation actions of water storage and release from our reservoirs and the delivery of water to our contractors.

5. RPA Action: NMFS Action 30 – "For those BOR projects located in the Columbia River and its tributaries downstream from Chief Joseph Dam . . ., BOR shall, as appropriate, work with NMFS in a timely manner to complete supplemental, project-specific consultations."

79. Columbia River Flood Control Assessment [*Under Development*]

80. Develop, and implement, if feasible, a revised storage reservation diagram for Libby reservoir that replaces the existing fall draft to a fixed end of December elevation [*Under Development*]

93. Annual Report on Canadian Treaty Water Storage
Action 24

On-going project

1. Project information

- **Purpose/Objective:** The ESA purpose of this RPA action is intended to put more water in the mainstem Columbia River during the juvenile salmon migration season (April through August).

- **Description:** This action item directs BPA and the Corps to continue to request and negotiate the annual non-power uses agreement with Canada. This agreement provides: 1) for the U.S., 1 Maf of spring/summer flow augmentation and assistance with Vernita Bar flows; and 2) for Canada, trout spawning flows and increasing lake levels in the spring for dust storm avoidance. In addition, the action item requests that the Corps and BPA seek additional amounts of storage for flow augmentation.

2. Major Activities/Tasks: BPA and the Corps will seek to negotiate a Non-Powers Uses agreement with Canada annually.

Milestone	Date (Mo/Yr)
Execution of Non-Power Uses agreement with Canada	Prior to spring period each year

3. Cost Estimate: No direct payments to Canada for BPA to implement this agreement. The cost to BPA from forgone power revenues varies from year to year is dependent on the water condition and market prices. The following table is a crude estimate of the range of potential costs to BPA.

Activity	FY02	FY03	FY04	FY05	FY06
Non – Power Uses Agreement	$0 to $50 million	$0 to $50 million	$0 to $50 million	$0 to $50 million	$0 to $50 million

4. Issues: Canada is willing to continue to this agreement on a year-to-year basis as long as it continues to provide mutual benefits for both parties. In addition, for the past five years, the U.S. has requested storage for flow augmentation in addition to current 1 Maf. Canada has been unwilling to consider additional storage amounts for U.S. flow augmentation due to water use concerns in Canada. Under Action 26, the parties are exploring alternatives that may meet Canadian needs – See Action 26.

5. RPA Action: NMFS action 24 – "BPA and the Corps shall continue to request agreements to annually provide 1 Maf of treaty storage from January through April 15, release the water during the migration season, and seek additional storage amounts."

94. Annual Report on Non-Treaty Canadian Water Storage
To support mainstream flow objectives
Action 25

On-going project

1. Project information

- **Purpose/Objective:** The ESA purpose of this RPA action is intended to put more water in the mainstem Columbia River during the juvenile salmon migration season (April through August).

- **Description:** This action item directs BPA to continue to request, and seek to negotiate an agreement for the storage of, water in Non-Treaty Storage (NTS) space during the spring for subsequent release during July and August.

2. Major Activities/Tasks: BPA will request and seek to negotiate a NTS letter agreement Canada to implement the desired operation as long as a NTS agreement exists with Canada annually.

Milestone	Date (Mo/Yr)
Execution on NTS letter agreement with Canada	Prior to May each year

3. Cost Estimate: No direct cost to BPA to implement this agreement. Given current market conditions, this agreement provides a benefit to BPA in most operating years.

Activity	FY02	FY03	FY04	FY05	FY06
NTS Letter Agreement	$0	$0	Unknown	Unknown	Unknown

4. Issues: Canada is increasingly frustrated with this agreement because: 1) it reduces the benefits they expected to receive under the NTS agreement; and 2) it causes environmental and recreation impacts on Canadian reservoirs. Mid-C parties are increasingly frustrated with their component/adjunct to this agreement because of the continuing reduction in their benefits. In addition, the current NTS agreement expires on 30 June 2003. It is increasingly unlikely that Canada will be willing to continue with the current status quo given water use issues in Canada. Given the current drought, BPA will be unable to store water in the spring for release in July and August for FY02.

5. RPA Action: NMFS action 25 – "BPA and the Corps (sic) shall continue to request, and negotiate with BC Hydro for storage of water in non-Treaty storage space during the spring for subsequent release in July and August for flow enhancement, as long as operations forecasts indicate that water stored in the spring can be released in July and August."

95. Annual Report on Additional Canadian Water Storage and Shaping
To support mainstream flow objectives
Action 26

On-going project

1. Project information

- **Purpose/Objective:** The ESA purpose of this RPA action is intended to put more water in the mainstem Columbia River during the juvenile salmon migration season (July and August).

- **Description:** This action item directs BPA and the Corps to evaluate, request, and negotiate with BC Hydro for shaping and release of Canadian water (Treaty and/or Non-Treaty) for July/August flow augmentation in addition to agreements under action items 24 and 25. Options for achieving additional flow include the installation of additional turbines at Mica and Revelstoke.

2. Major Activities/Tasks: The Columbia River Treaty Operating Committee (BPA, the Corps, and BC Hydro staff) will prepare a preliminary report on feasibility on increasing discharges from Canadian storage in July and August. The Operating Committee will submit the report for the consideration of the Entities. Provided both Entities agree on a preferred alternative(s), and consent to proceed, the Operating Committee will be directed to begin negotiation of a proposed Entity agreement. If successful, the Entities will then implement the agreed operation.

Milestone	Date (Mo/Yr)
1. Complete feasibility report and submit to Entities	Pending
2. Negotiate proposed Entity Agreement	On hold
3. Implement Entity Agreement	On hold

3. Cost Estimate: Assuming the installation of additional units at Mica and Revelstoke to facilitate Canadian water releases during July and August is determined to be feasible, BPA will likely make a substantial investment in infrastructure. The estimated cost is speculative at this point until more comprehensive studies are completed, and a preferred alternative is selected. Due to the issues involved in completion of the proposed agreement and the lead time associated with installation of new units, cost would not be expected begin until FY05 or later.

Activity	FY02	FY03	FY04	FY05	FY06
Add Units at Mica/Rev	$0	$0	$0	$0 to $30 million	$0 to $30 Million

4. Issues: Canada is currently undergoing a comprehensive water use planning effort for the upper Columbia and other basins within Canada. Any agreement between the U.S. and Canada will consider the power, recreation, environmental, and other impacts in Canada and the U.S., and must be coordinated with Canadian water use planning efforts. Staff work on this RPA is currently on hold because the only available staff at BPA, the Corps, and BC Hydro are working to implement action item 22, implementation of VARQ flood control at Libby.

5. RPA Action: NMFS action 26 – "BPA and the Corps shall continue to evaluate, request, and negotiate with BC Hydro the shaping and release of water behind Canadian Treaty storage projects in addition to the non-Treaty storage water previously discussed during July and August."

Annual Water Management Plan

Each year the action agencies will prepare a 1-year BiOp implementation plan that covers actions in the upcoming year. These plans are to be complete at the end of September and thus will most likely will be in draft form around July. The time period covered in the one-year implementation plan will be the upcoming fiscal year which begins on October 1 and ends on September 30 the following year. Because the one year plan will written in the June / July time period very little, if any information will be known about what water conditions (water supply /outlook) will be during the time period covered in the one year plan. Due to the lack of information the one-year water management portion of the 1-year implementation plan will be a generic plan. It will describe any special operations (such as special test, implementation of VARQ at a project) that are planned during that year.

In discussions with the action agencies about the water management plan it has been tentatively decided that two updates to the water management portion of the one-year plans will be prepared in order to flesh out how the action agencies will operate the FCRPS projects. The first update, the fall update, to the one year plan will be prepared in the fall, around October and will deal with the fall / winter operation of the FCRPS projects. The second update, the spring update, will be prepared in March / April (timing similar to the current water management plan) and will deal with the spring / summer operation of the FCRPS projects.

The fall update will deal with operations that occur in the fall / winter period. Operations that occur during this time period include; The chum flow levels provided below Bonneville Dam. Reservoir refill, Flood control operations and any other operations scheduled during this time period.

The spring update will deal with operations that occur in the spring / summer period. By this time we should have a good idea of what the water supply outlook for the rest of the year will be. With this information we can begin to plan what to do in the spring and summer. Operations that occur in this time period include; Setting flow objectives and planning flow augmentation, Setting up spring and summer fish spill, MOP operation at the Lower Snake projects, Determining when to transport juvenile fish from McNary, and other operations that occur during this time period.

Water Management Decision Points

The paragraphs below list the key water management decision points and when they occur. Some "decision points," such as setting flow objectives, should not need much discussion as what is to occur is spelled out in the BiOps. Other "decision points," such as setting flow augmentation goals, will require much discussion and coordination. Some of the "decision points" given below are spelled out in the BiOps some are based on past experience.

Early October
Based on best hydrologic data available at the time, the level of flow can be sustained for chum spawning below Bonneville Dam should be set. Flows for chum occur from around late October or early November, the start of spawning, until April, the end of emergence. Also at this time

preliminary discussions on flood control / project refill strategy for the upcoming flood control season could occur. Albeni Falls fall / winter drawdown strategy discussion should also occur at this time. The fall / winter update to the one year implementation plan should be complete at this time.

Late December
Two main items need to be discussed around this time. The winter / spring chum flow levels below Bonneville Dam need to be set. The second item to be discussed is flood control and refill strategies for the winter and spring. Any available flood control shifts could be discussed. (This may need to occur later)

Early March
The minimum flows from Hungry Horse Dam and the minimum Columbia Falls flows are set by the April – August forecast for Hungry Horse. Also by this time there should be a good idea of what the water supply for the year will be. Discussions should begin about how the FCRPS projects will be operated during the spring. Another operation that needs to be discussed at this time is the Spring Creek Hatchery release. Preliminary work on the spring / summer update to the one year implementation plan need to begin at this time (could also be begun earlier). Fish transport operations discussions can occur.

Early April
Many decisions occur during this time period. Water supply forecasts by this time should give us a very good picture of what we can expect in the spring. The spring flow objectives are set by the April final forecasts at various points. A spring flow augmentation strategy should be determined. This flow augmentation strategy should set how available flow augmentation water should be used (shaped verses flat flow etc.), what priority is refill, and any other details. Start dates and spill levels (Spill or not at Lower Snake Collectors projects) needs to be set at this time. The start of Mop at the Lower Snake projects and John Day forebay elevations need to be set. The spring / summer update to the one year implementation plan needs to be completed at this time. Libby and Hungry operational plans need to started by this time (could be started earlier).

Early May
Libby (which discusses any Libby sturgeon operations) and Hungry Horse operational plans are due at this time.

Early June
The summer flow objective at Lower Granite is determined by the June final forecast. The summer flow augmentation strategy should be determined at this time. Temperature modeling for Dworshak outflows should be completed so a Dworshak release strategy can be determined. The decision to start juvenile fish transport at McNary normally comes at this time.

Early July
The Grand Coulee summer reservoir draft limit is set by the July final forecast.

A draft of a generic 1-Year Water Management Plan is included as a reference. Cross references to statements within the Biological Opinions that prescribe Water Management approaches and actions are included where appropriate.

The Federal Agencies 2001 FCRPS Operations Plan is also included as a reference. This plan was prepared for a year with drought conditions. If the water supply forecast for 2002 predicts more normal water conditions, seasonal flows will be more like those recommended in the BiOp and included in the "Generic One-Year Water Management Plan."

References:

Generic One-Year Water Management Plan
Federal Agencies 2001 FCRPS Operations Plan

Generic One-Year Water Management Plan

Public Coordination

Actions in the Water Management Plan will be coordinated with NMFS, USFWS, and the states and Tribes in preseason planning and in-season management of flow and spill operations This coordination shall occur in the Technical Management Team process. (NMFS BiOp @ Section 9.4.2.2 Page 9-27, Action 3)

At all appropriate decision points the action agencies shall routinely, and, seek timely input and concurrence from the Service on all matters affecting listed fish through the Columbia River Treaty, International Joint Commission Orders, and all other decisionmaking processes involving transboundary waters in the Columbia River basin. This shall include notification of all meetings and decision points and provision of opportunity to advise the action agencies during meetings and in writing as appropriate (USFWS BiOp @ Section 8.1.g Page 76, Action-f 7)

Water supply forecasts

Water supply forecasts used to manage the Columbia River are provided by the National Weather Service's Northwest River Forecast Center and the Corps of Engineers Northwest Division Hydrologic Engineering Branch. The table below lists the forecasts that are referenced by the NMFS 2000 BiOp and the USFWS 2000 BiOp.

Forecast Point	Forecast period	Forecast	What does it control	BiOp reference	Implementation Plan Reference	RPA Action Item
Lower Granite	April - July	April Final	Spring Flow objective at Lower Granite	NMFS BiOp @ Section 9.6.1.2.1 Page 9-57	6.5.1.3.1	Action 14

Forecast Point	Forecast period	Forecast	What does it control	BiOp reference	Implementation Plan Reference	RPA Action Item
Lower Granite	April – July	June Final	Summer Flow objective at Lower Granite	NMFS BiOp @ Section 9.6.1.2.1 Page 9-57	6.5.1.5.1	Action 14
The Dalles	April – August	April Final	Spring Flow objective at McNary Dam	NMFS BiOp @ Section 9.6.1.2.1 Page 9-57	6.5.1.3.1	Action 14
Hungry Horse	April – August	March Final	Hungry Horse minimum flows	NMFS BiOp @ Section 9.6.1.2.3 Page 9-63 USFWS BiOp @ Section 3.A.1 Page 6	6.5.1.4.4.2	Action 19
Hungry Horse	April – August	March Final	Columbia Falls minimum flow	NMFS BiOp @ Section 9.6.1.2.3 Page 9-63 USFWS BiOp @ Section 3.A.1 Page 7	6.5.1.4.4.3	Action 19
The Dalles	April - August	July Final	Grand Coulee Summer Draft Limit	NMFS BiOp @ Section 9.6.1.2.3 Page 9-64	6.5.1.5.2.3	Action 19
Libby	April - August		Volume of Water for Sturgeon Flow at Bonners Ferry and Minimum bull trout flows between sturgeon and salmon flows	USFWS BiOp @ Section 8.1 Page 74 and USFWS BiOp @ Section 3.A.2 Page 15	6.5.1.3.7	Action f-3

Fall operations

Operation for chum salmon below Bonneville dam - If the best hydrologic data available by early October indicate that precipitation, runoff, and reservoir storage are likely to support the operation from the start of spawning (late October or early November) until the end of emergence (generally through the start of the spring flow augmentation season in April). (NMFS BiOp @ Section 9.6.1.2.1 Page 9-58, Action 15). The FCRPS projects shall be operated to provide a minimum flow below Bonneville Dam of 125 Kcfs (or more as coordinated) from when chum salmon are found in the area around Ives and Pierce Islands (but no later than November 1) through December 31. The flows from Bonneville dam will maintain flows within 5 kcfs of the established minimum. If decided by coordination the flow levels may be set to a minimum Bonneville tail water elevation.

If water supply conditions indicate that it is not possible to provide a minimum flow of 125 Kcfs enough flow from Bonneville Dam will be provided during the chum-spawning season at time to allow access to Hamilton and Hardy Creeks. Details will be set through coordination in TMT. (NMFS BiOp @ Section 9.6.1.2.1 Page 9-60, Action 16)

Albeni Falls Turbine Operations - See turbine operations below.

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Dworshak - After summer fish operations flows from Dworshak shall be limited to minimum one turbine operation (approximately1500 cfs) unless higher flows are required for flood control. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-65, Action 19)

Canadian Storage - 1 Maf of Treaty storage shall be requested and negotiated with BC Hydro to be provided and released during the migration season. (NMFS BiOp @ Section 9.6.1.2.5 Page 9-67, Action 24)

Libby operations - Libby dam flows shall be regulated consistent with existing treaties, Libby Project authorization for public safety, other laws, and the 1938 IJC order, to achieve water volumes, water velocities, water depths, and water temperature at a time to maximize the probability of allowing significant sturgeon recruitment. (USFWS BiOp @ Section 8.1.a Page 73, Action-f 1)

Operational constraints will be implemented at Libby Dam intended to minimize adverse effects of rapid and severe river flow fluctuations on bull trout, including year-round minimum flows and ramping rates, seasonal water management, conducting studies to monitor the adequacy of the constraints, and providing for modification of the operational constraints depending on study results. (USFWS BiOp @ Section 10.A.1 Page 87, Action-f 42) Exact operational constraints shown in paragraphs below.

The following ramp rates will be used.

Daily and hourly maximum ramp up rates for Libby Dam
(as measured by daily flows, not daily averages, restricted by hourly rates).

Ramp Up Rates - Libby Dam			
Flow Range	**Ramp Up Unit (Daily max)**	**Ramp Up (Hourly max) 1 Oct – 30 Apr**	**Ramp Up (Hourly max) 1 May – 30 Sep**
4,000 - 6,000 cfs	Limit ramp up to one unit per day (approx. 5,000 cfs per day)	2,000 cfs/hr	1,000 cfs/hr
6,000 - 9,000 cfs	Limit ramp up to one unit per day (approx. 5,000 cfs per day)	2,000 cfs/hr	1,000 cfs/hr
> 9,000 - 17,000 cfs	Limit ramp up to one unit per day (approx. 10,000 cfs per day)	3,500 cfs/hr	2,000 cfs/hr
> 17,000 cfs	No limit	7,000 cfs/hr	3,500 cfs/hr

(USFWS BiOp @ Section 3.A.2 Page 13)

Daily and hourly maximum ramp down rates for Libby Dam
(as measured by daily flows, not daily averages, restricted by hourly rates).

Ramp Down Rates - Libby Dam			
Flow Range	**Ramp Down Unit (Daily Max)**	**Ramp Down (Hourly max) 1 Oct – 30 Apr**	**Ramp Down (Hourly max) 1 May – 30 Sep**
4,000 - 6,000 cfs	Limit ramp down to 500 cfs per day	500 cfs/hr	500 cfs/hr
> 6,000 - 9,000 cfs	Limit ramp down to 1,000 cfs per day	500 cfs/hr	500 cfs/hr
> 9,000 - 17,000 cfs	Limit ramp down to 2,000 cfs per day	1,000 cfs/hr	1,000 cfs/hr
> 17,000 cfs	Limit ramp down to one unit per day (approx. 5,000 cfs per day)	5,000 cfs/hr	3,500 cfs/hr

(USFWS BiOp @ Section 3.A.2 Page 14)

Daily and hourly ramping rates may be exceeded during flood emergencies to protect health and public safety and in association with power or transmission emergencies. (USFWS BiOp @ Section 3.A.2 Page 14)

Variances to ramping rates during years where runoff forecasting or shortage shortfalls occur, or variances are necessary to provide augmentation water for other listed species, will be negotiated through the TMT process. This is expected in only the lowest 20th percentile water years. (USFWS BiOp @ Section 3.A.2 Page 14)

Note: The recommended ramp rates will be followed except if the recommended ramp rate causes a unit(s) to operate in the rough zone, a zone of chaotic flow in which all parts of a unit are subject to increased vibration and cavitation that could result in premature wear or failure of the units. In this case the project will utilize a ramp rate which allows all units to operate outside the rough zone. The action agencies will provide additional information to the Service describing operations outside the "rough zone." (USFWS BiOp @ Section 3.A.2 Page 13)

Hungry Horse Operations - Operational measures will be implemented at Hungry Horse Dam intended to minimize adverse effects of rapid and severe river flow fluctuations on bull trout, including year-round minimum flows and ramping rates, and seasonal water management; conduct studies to monitor the adequacy of the constraints; and provide for modification of the operational constraints depending on study results. (USFWS BiOp @ Section 10.A.1 Page 87, Action-f 43) Exact operational constraints shown in paragraphs below.

The following ramp rates will be used.

Daily and hourly maximum ramp up rates for Hungry Horse Dam
(as measured by daily flows, not daily averages, restricted by hourly rates).

Ramp Up Rates - Hungry Horse Dam		
Flow Range (measured at Columbia Falls)	**Ramp Up Unit (Daily Max)**	**Ramp Up Unit (Hourly max)**
3,500 - 6,000 cfs	Limit ramp up 1,800 cfs per day	1,000 cfs/hour
> 6,000 - 8,000 cfs	Limit ramp up 1,800 cfs per day	1,000 cfs/hour
> 8,000 - 10,000 cfs	Limit ramp up 3,600 cfs per day	1,800 cfs/hour
> 10,000 cfs	No limit	1,800 cfs/hour

(USFWS BiOp @ Section 3.A.1 Page 8)

Daily and hourly maximum ramp down rates for Hungry Horse Dam
(as measured by daily flows, not daily averages, restricted by hourly rates).

Ramp Down Rates - Hungry Horse Dam		
Flow Range (measured at Columbia Falls)	**Ramp Down Unit (Daily max)**	**Ramp Down Unit (Hourly max)**
3,500 - 6,000 cfs	Limit ramp down to 600 cfs per day	600 cfs/hour
> 6,000 - 8,000 cfs	Limit ramp down to 1,000 cfs per day	600 cfs/hour
> 8,000 - 12,000 cfs	Limit ramp down to 2,000 cfs per day	1,000 cfs/hour
> 12,000 cfs	Limit ramp down to 5,000 cfs per day	1,800 cfs/hour

(USFWS BiOp @ Section 3.A.1 Page 8)

Daily and hourly ramping rates may be exceeded during flood emergencies to protect health and public safety and in association with power or transmission emergencies. (USFWS BiOp @ Section 3.A.1 Page 8)

Variances to ramping rates during years where runoff forecasting or storage shortfalls occur, or variances are necessary to provide augmentation water for other listed species, will be negotiated through the TMT process. This is expected in only the lowest 20th percentile water years. (USFWS BiOp @ Section 3.A.1 Page 8)

Note: The recommended ramp rates will be followed except if the recommended ramp rate causes a unit(s) to operate in the rough zone, a zone of chaotic flow in which all parts of a unit are subject to increased vibration and cavitation that could result in premature wear or failure of the units. In this case the project will utilize a ramp rate which allows all units to operate outside the rough zone. The action agencies will provide additional information to the Service describing operations outside the "rough zone." (USFWS BiOp @ Section 3.A.1 Page 7)

Winter Operations

Reservoir refill - The FCRPS dams will be operated during the winter season in order to achieve a high probability of water surface elevations within 0.5 foot of the flood control rule curve by April 10 and to refill by June 30, except as specifically provided by the Technical Management Team. (NMFS BiOp @ Section 9.6.1.2.1 Page 9-56, Action 14and NMFS BiOp @ Section 9.6.1.2.3 Page 9-61, Action 18).

Reservoir and reservoir related operations

> **Hungry Horse (USBR)** - Hungry Horse will operate using VARQ starting January 1, 2001. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-62 Action 19)
> See section 6.5.1.2.7 above
> **Libby** – See Libby Fall Operation above.

Chum operations below Bonneville Dam - From January 1 to April 10 (the start of spring flow augmentation) if the chum operation is possible as indicated in section 6.5.1.2.1 the flow from Bonneville dam will be to the daily minimum as set be coordination or to provide a minimum water surface elevation as set be coordination. (NMFS BiOp @ Section 9.6.1.2.1 Page 9-58, Action 15).

If the minimum flow set for the fall chum operation (Section 6.5.1.2.1) is 125 kcfs the minimum flow shall be 125 kcfs. If the minimum flow for the fall chum operation is 135 kcfs or greater the minimum flow with be 10 kcfs lower than the fall minimum chum flow. The minimum flow in no case will be greater than 150 kcfs.

Flood Control Shifts - Opportunities to shift flood control requirements from Brownlee and Dworshak to Grand Coulee shall be considered. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-65, Action 21). These shifts may be implemented after coordination with TMT.

Spring Operations

Spring flow objectives at Lower Granite and McNary - The spring flow objective at Lower Granite Dam is set according to the April final runoff volume forecast at Lower Granite Dam for April to July. (NMFS BiOp @ Section 9.6.1.2.1 Page 9-57, Action 14). When the forecast is less than 16 Maf the flow objective will be 85 kcfs. If the forecast is between 16 Maf and 20 Maf the flow objective will be linearly interpolated between 85 kcfs and 100 kcfs. If the forecast is greater than 20 Maf the flow objective will be 100 kcfs. The planning dates for the flow objective will be from April 3rd to June 20th.

The spring flow objective at McNary Dam is set according to the April final runoff volume forecast at The Dalles Dam for April to August (NMFS BiOp @ Section 9.6.1.2.1 Page 9-57, Action 14). When the forecast is less than 80 Maf the flow objective will be 220 kcfs. If the forecast is between 80 Maf and 92 Maf the flow objective will be linearly interpolated between 220 kcfs and 260 kcfs. If the forecast is greater than 92 Maf the flow objective will be 260 kcfs. The planning dates for the flow objective will be from April 10th to June 30th.

Spring flow objective for Mid-Columbia River - The spring flow objective at Priest Rapids dam is 135 kcfs. (NMFS BiOp @ Section 9.6.1.2.1 Page 9-57, Action 14). The planing dates are from April 10 to June 30.

Lower Snake reservoirs at MOP - The Lower Snake Reservoirs will operate within 1 foot of MOP (Minimum Operating Pool) from approximately April 3 until small numbers of juvenile migrants are present. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-65, Action 20). Lower Granite Dam shall not return to normal operating pool until enough natural cooling has occurred in the fall, generally after October 1.

Other Reservoirs

> **John Day Pool Elevation -** John Day John Day pool within a 1½-foot range of the minimum level that provides irrigation pumping from April 10 to September 30. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-65, Action 20)
> **Hungry Horse** (USBR) - An annual operational schedule to be supplemented on a monthly basis will be provided to the Service annually, on or about May 1 but not later that May 10,. The annual schedule shall include month-end estimates of water surface elevation at Hungry Horse Reservoir and estimates of monthly discharge from Hungry Horse Dam. The monthly supplement shall include a report of actual operations over the previous month and shall include daily water surface elevation at Hungry Horse

Reservoir and hourly spill and releases at Hungry Horse Dam. (USFWS BiOp @ Section 11.A.1.2.a Page 93, Action-f 61)

The minimum outflow for Hungry Horse Dam from April – August is based on the April – August runoff forecast for Hungry Horse. If the forecast is greater than 1,790 kaf the minimum flow shall be 900 cfs. If the forecast is less than 1,190 kaf the minimum flow shall be 400 cfs. If the forecast is between 1,190 and 1,790 kaf the minimum flow will be interpolated between 400 and 900 cfs. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-63, Action 19). (USFWS BiOp @ Section 3.A.1 Page 6) The minimum flow from Hungry Horse can be lowered to 145 cfs when the river at Columbia Falls reaches flood level (13 feet) See also fall operations above.

Columbia Falls Minimum Flow - The minimum flow at Columbia Falls from April – August is based on the April – August runoff forecast for Hungry Horse. If the forecast is greater than 1,790 kaf the minimum flow shall be 3500 cfs. If the forecast is less than 1,190 kaf the minimum flow shall be 3200 cfs. If the forecast is between 1,190 and 1,790 kaf the minimum flow will be interpolated between 3200 and 3500 cfs. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-63, Action 19)). (USFWS BiOp @ Section 3.A.1 Page 7).

Spring spill for fish passage - Spring spill for juvenile fish migration shall occur from (planning dates) April 3rd to June 20th in the Snake River, and April 10 to June 30 in the lower Columbia River. (NMFS BiOp @ Section 9.6.1.4.3 Page 9-88, Action 54). Spill levels and times are indicated below. (NMFS BiOp @ Section 9.6.1.4.4 Page 9-88, Action 54 and NMFS BiOp @ Section 9.6.1.3.4 Page 9-76, Action 41). Voluntary spill at all three Snake River collector projects shall occur when seasonal average flows are projected to meet or exceed 85 kcfs. (NMFS BiOp @ Section 9.6.1.3.2 Page 9-76, Action 40)

Lower Granite - Spill to 120/115 gas cap from 1800 – 0600. BPA has a minimum generation requirement of 11.5 kcfs which may not always be needed.
Little Goose - Spill to 120/115 gas cap from 1800 – 0600. BPA has a minimum generation requirement of 11.5 kcfs which may not always be needed.
Lower Monumental - Spill to 120/115 gas cap 24 hours a day. BPA has a minimum generation requirement of 11.5 kcfs which may not always be needed.
Ice Harbor - Spill to 120/115 gas cap from 1800 – 0500. Spill 45 kcfs from 0500 – 1800 (due to concerns about adult fall back). BPA has a minimum generation requirement of 7.5 to 9.5 kcfs which may not always be needed.
McNary - Spill to 120/115 gas cap from 1800 – 0600. BPA has a minimum generation requirement of 50 kcfs.
John Day - Spill 60% of project outflow not to exceed the 120/115 gas cap from 1800 – 0600 except from May 15 – July 31 when the spill hours will be 1900 – 0600. Minimum spill level 25%. BPA has a minimum generation requirement of 50 kcfs.
The Dalles - Spill 40% of project outflow not to exceed the 120/115 gas cap 24 hours a day. BPA has a minimum generation requirement of 50 kcfs.
Bonneville - During nighttime spill to the 120/115 gas cap. During daytime spill 75 kcfs (due to concerns with adult fallback). Day and nighttime vary during the spill season and

are set in a table in the Fish Passage Plan. Minimum spill level is 50 kcfs. BPA has a minimum generation requirement of 30 kcfs.

Chum operations below Bonneville Dam - The flows from the spring flow objectives are consider sufficient to provide protection for chum salmon redds.

Libby Operations for white sturgeon and bull trout - An annual operational schedule to be supplemented on a monthly basis will be provide to the Service annually, on or about May 1 but not later that May 10, The annual schedule shall include month-end estimates of water surface elevation at Koocanusa Reservoir and estimates of monthly discharge from Libby Dam. The monthly supplement shall include a report of actual operations over the previous month and shall include daily water surface elevation at Koocanusa Reservoir and hourly spill and releases at Libby Dam. (USFWS BiOp @ Section 11.A.1.1.c Page 93, Action-f 60) Also See Libby Fall Operations above.

Water shall be stored in Libby reservoir and supply, at a minimum, water volumes during May, June and July based upon a water availability or "tiered" approach as defined and summarized the table below. This water shall be in addition to storage needs for listed bull trout, salmon, and the 4,000 cfs minimum releases from Libby Dam. Accounting on these total tiered volumes shall begin when the Service determines benefits to conservation of sturgeon are most likely to occur. This may include releases timed to enhance survival of eggs, yolk sac larvae, or larvae reared under the preservation stocking program and released into the Kootenai River. Releases may be timed to serve both wild fish and hatchery eggs/fish. Sturgeon flows will generally be initiated between mid-May and the end of June to augment lower basin runoff entering the Kootenai River below Libby Dam. (USFWS BiOp @ Section 8.1.c Page 73, Action-f 3)

Minimum "tiered" volumes of water for sturgeon flow enhancement to be provided at Bonners Ferry according to April-August volume runoff forecasts at Libby.

Forecast runoff Volume (maf) at Libby	Tier	Sturgeon Flow (maf) at Bonners Ferry
0.00 < forecast < 4.80	1	Sturgeon flows not requested
4.80 < forecast < 6.00	2	1.42
6.00 < forecast < 6.70	3	1.77
6.70 < forecast < 8.10	4	2.56
8.10 < forecast < 8.90	5	3.89
8.90 < forecast	6	4.77

Libby outflow will fulfill the operational guidelines provided by the Service annually prior to and during the sturgeon spawning/incubation period. Specific release recommendations will be developed in consultation with action agencies and submitted annually through the TMT or similar regional process. (USFWS BiOp @ Section 8.2.c Page 80, Action-f 20)

Efforts will be coordinated to attempt to limit sturgeon spawning flows so they do not exceed a levee elevation of 1,764 feet at Bonners Ferry. (Note: This may not always be possible during

periods of unusual local runoff which may be beyond control of Libby Dam.) (USFWS BiOp @ Section 8.3.b Page 80, Action-f 23)

Daily load following in the outflow from Libby Dam will be limited to the extent that levees in Kootenai Valley are no longer damaged, and public outreach materials addressing this issue shall be provided. (USFWS BiOp @ Section 8.3.f Page 81, Action-f 27)

During sturgeon recruitment flow periods, local inflow will be allowed to supplement Libby Dam releases to the maximum extent feasible, while assuring public safety by monitoring water levels throughout relevant areas of the Kootenai River basin. (USFWS BiOp @ Section 8.3.g Page 81, Action-f 28)

Water temperature profiles in the south end of Lake Koocanusa during May and June will be monitored to provide information necessary for timing of sturgeon spawning/rearing flow augmentation. (USFWS BiOp @ Section 8.3.h Page 82, Action-f 29)

The following minimum flow between the sturgeon and salmon flows will be provided based on the April – August volume runoff forecast at Libby.

Forecast runoff Volume (maf*) at Libby	**Min bull trout flows between sturgeon and salmon flows**
0.00 < forecast < 4.80	6 kcfs
4.80 < forecast < 6.00	7 kcfs
6.00 < forecast < 6.70	8 kcfs
6.70 < forecast < 8.10	9 kcfs
8.10 < forecast < 8.90	9 kcfs
8.90 < forecast	9 kcfs

(USFWS BiOp @ Section 3.A.2 Page 13)

During water year 2001, (prior to implementation of VARQ), a means shall be sought to store and release sufficient water to provide for bull trout base flow prior to salmon flows and associated ramping volumes. The action agencies will adhere to the described ramping rates and minimum flows, as described in the revised proposed action. Should VARQ not be adopted by water year 2001, these alternative storage procedures, ramping rates and minimum flows will continue for the duration of this biological opinion or with modifications agreed to during re-initiation of consultation. (USFWS BiOp @ Section 11.A..1.a Page 92, Action-f 58)

Spring Operations General - During the spring, the Action Agencies shall operate the FCRPS to meet the flow objectives and refill the storage reservoirs (Albeni Falls, Dworshak, Grand Coulee, Hungry Horse, and Libby) by approximately June 30. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-61, Action 18). If both these objectives cannot be achieved, the Technical Management Team will make an in-season decision, weighing considerations unique to each particular year. Because research results indicate that flow augmentation has more direct survival benefits for summer than spring migrants, modest reductions in spring flows to facilitate reservoir refill would generally be preferable to refill failure.

Turbine Operation - All turbine units at FCRPS dams shall be operated for optimum fish passage survival. The Corps and BPA, in coordination with the Fish Passage Operations and Maintenance Coordination Team (FPOM). (NMFS BiOp @ Section 9.6.1.4.4 Page 9-93, Action 58) Turbines will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (March 15 through October 31 in the Columbia River and March 15 through November 30 in the Snake River) as indicated by the load-shaping guidelines contained in the Corps' annual Fish Passage Plan.

Canadian Storage - The use of non-Treaty storage shall be requested and negotiated with BC Hydro to be used to store water to for flow enhancement provided operation forecasts indicate that the water stored in the spring can be released in July and August. (NMFS BiOp @ Section 9.6.1.2.5 Page 9-67, Action 25)

The shaping and release of water behind Canadian Treaty storage projects in July and August shall be evaluated, requested and negotiated with BC Hydro .(NMFS BiOp @ Section 9.6.1.2.5 Page 9-67, Action 26)

Summer operations

Summer flow objective at Lower Granite and McNary - The summer flow objective at Lower Granite Dam is set according to the June final runoff volume forecast at Lower Granite Dam for April to July. (NMFS BiOp @ Section 9.6.1.2.1 Page 9-57, Action 14). When the forecast is less than 16 maf the flow objective will be 50 kcfs. If the forecast is between 16 maf and 20 maf the flow objective will be linearly interpolated between 50 kcfs and 55 kcfs. If the forecast is greater than 20 maf the flow objective will be 55 kcfs. The planning dates for the flow objective will be from June 21 to August 31.

The spring flow objective at McNary Dam is 200 kcfs (NMFS BiOp @ Section 9.6.1.2.1 Page 9-58, Action 14). The planning dates for the flow objective will be from July 1 to August 31.

Summer reservoir draft limits

Hungry Horse - The summer reservoir draft limit is 3540 feet (NMFS BiOp @ Section 9.6.1.2.3 Page 9-63, Action 19).

Libby - The summer reservoir draft limit is 2439 feet (NMFS BiOp @ Section 9.6.1.2.3 Page 9-63, Action 19). If Libby is below 2439 on July 1st Libby will provide the USFWS bull trout minimum flow or inflow during July. (USFWS BiOp @ Section 11.A..1.a Page 93, Action-f 59)

Grand Coulee - The summer reservoir draft limit is 1,280 feet in years where the July final at The Dalles is equal to or less than 92 MAF, if the forecast is less than 92 maf the draft limit will be 1,278 feet (NMFS BiOp @ Section 9.6.1.2.3 Page 9-64, Action 19).

Dworshak - The summer reservoir draft limit is 1520 feet (NMFS BiOp @ Section 9.6.1.2.3 Page 9-65, Action 19).

Upper Snake River reservoir operation - (to be defined by BOR)

Summer reservoir operations

Hungry Horse Minimum Outflow – See Hungry Horse Spring operation above.
Columbia Falls Minimum Flow – See Columbia Falls spring operation above.
Dworshak Summer Operation - During the summer, release shall be made from Dworshak to attempt to maintain water temperatures at the Lower Granite forebay water quality station at or below 68^{o} F. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-65, Action 19)
Banks Lake -Banks Lake will be operated at an elevation 5 feet from full during August. (NMFS BiOp @ Section 9.6.1.2.4 Page 9-67, Action 23)

Summer spill for fish passage - Summer spill for juvenile fish migration shall occur from (planning dates) June 21 to August 31 in the Snake River, and July 1 to August 31 in the lower Columbia River. (NMFS BiOp @ Section 9.6.1.4.3 Page 9-88, Action 54). There will be no summer spill at the four collector projects (Lower Granite, Little Goose, Lower Monumental, and McNary) (NMFS BiOp @ Section 9.6.1.3.2 Page 9-76, Action 42). The spill levels for the remaining four Projects (Ice Harbor, John Day, The Dalles, Bonneville) are the same as listed in for Spring Spill above.

Turbine Operation - See winter operation above.

Libby -See fall operation above.
Hungry Horse - See fall operation above.

Outlook for Meeting Flow Objectives

To be described in Annual report and in seasonal updates.

Water temperature

Water temperature objectives will be described in the Annual report and in the seasonal updates.

Total dissolved gas management

(USFWS BiOp @ Section 11.A..1.3.c Page 94, Action-f 64) will be covered here.

Juvenile fish transportation **(Hurson)**

All non-research juvenile salmonids collected at the Snake River collector projects will be transported. (NMFS BiOp @ Section 9.6.1.3.2 Page 9-76, Action 40)

Structural and operational alternatives to improve juvenile transportation at the collector dams will be evaluated and implemented. (NMFS BiOp @ Section 9.6.1.3.4 Page 9-81, Action 53)

McNary - Juvenile spring migrants collected at McNary Dam shall be bypassed. (NMFS BiOp @ Section 9.6.1.3.4 Page 9-76, Action 41)

Collection of subyearling fall chinook for transportation at McNary Dam shall not be initiated until inriver migratory conditions are deteriorating (i.e., no longer spring-like). (NMFS BiOp @ Section 9.6.1.3.4 Page 9-77, Action 43) In general, the switch from spring to summer operation will occur on or about June 20. Spring-like is defined as favorable flow and water temperature conditions; i.e., river flows are at or above the spring flow target (220 to 260 kcfs) at McNary Dam, and ambient water temperatures are below 62°F (17C°). Actual dates shall be set by TMT coordination.

Operations for research and other activities

Libby Spill Test - A Libby spillway test in 2001 will be conducted under sufficiently high turbine discharge levels during the sturgeon conservation operation to reliably estimate the maximum spillway flow dilution capability and compliance with the state water quality standard of 110 percent gas saturation, with up to six (6) turbines operating at full capacity, and/or a total release capacity of 35,000 cfs through a combination of spillways and a turbine. Possible changes in dissolved gas concentrations throughout the Kootenai River shall be evaluated. This test shall also include monitoring of effects of the spill on bull trout and other fish in the Kootenai River. (USFWS BiOp @ Section 8.2.a.1 Page 78, Action-f 10)

Operations for emergencies and unforeseen situations

The annual water management plan will provide information on the following:

- Power system reliability
- Low water supply
- Economic conditions
- Fish conditions

Appendices – TDG gas mgt. plan, emergency protocols, etc

Following will be covered here:
(NMFS BiOp @ Section 9.6.1.7.2 Page 9-122, Action 131)
(NMFS BiOp @ Section 9.6.1.7.2 Page 9-122, Action 123)

Additional Water Management Actions

VARQ Flood Control Operation

Libby –

Link to RPA's - USFWS BIOP Section 8.1. page 73, Action-f2
A schedule shall be developed by January 2001 including all disclosures, NEPA compliance and additional Canadian coordination necessary to implement VARQ flood control/storage at Libby Dam.

NMFS BIOP Section 9.6.1.2.3 Page 63, **Action 19** and Section 9.6.1.2.3 Page 9-66, **Action 22**
USFWS BIOP Section 8.1.b Page 73, Action-f2

VARQ shall be implemented (Corps 1999d) as a flood control operations strategy by October 1, 2001, and upon completion of coordination with appropriate Canadian Entities.

Major Activities and Milestones - A process is currently underway within the Corps and with other action agencies to address funding, scoping, and scheduling of the activities such as NEPA compliance and coordination required for implementation of VARQ flood control/storage at Libby Dam.

System Flood Control

Link to RPA's - NMFS BIOP Section 9.6.1.2.6 Page 72, **Action 35**. The COE shall develop and conduct a detailed feasibility analysis of modifying current system flood control operations to benefit the Columbia River ecosystem including salmon. …Within 6 months of receiving funding, the Corps shall provide a feasibility analysis study plan for review to NMFS and all interested agencies……A final study plan shall be provided to NMFS and all interested agencies 4 months after submitting the draft plan for review.

Major Activities and Milestones - COE-Portland District is the lead for this effort. Current efforts include funding an Initial Appraisal (Section 216 Project) in 2001. The Initial Appraisal will be a reconnaissance level study. Assuming completion of the Initial Appraisal in 2001, the earliest date for Congressional Funding of a Feasibility Study will be 2003. Given the funding limitations, it is doubtful that the draft feasibility study will be completed by 2005 as addressed in the BIOP.

Link to RPA's - NMFS BIOP Section 9.6.1.2.6 Page 33, **Action 36** By October 1, 2002, the COE shall develop and , if feasible, implement a revised storage reservation diagram for Libby Reservoir that replaces the existing fall draft to a fixed end-of-December elevation. One option is to evaluate variable drafts based on the El Nino Southern Oscillation Index (SOI) predictions or other forecast methodologies of runoff volume. To implement this change, the COE shall complete successful coordination with Canada under the Columbia River Treaty.

Major Activities and Milestones - The COE is currently looking at utilization of SOI or other forecast methodologies in regression procedures for early season runoff forecasts. In the short term, the COE is using the SOI-based runoff model for Dworshak as a template. The forecast study was initiated in January 2001 and completion is estimated to be early 2002. For the long term, if results are promising, adjustments to the storage reservation diagram will be studied as an alternative to the fixed end of December draft. Hydroregulation studies will be needed to analyze local and system flood control impacts. Additionally, it is assumed that all disclosures such as NEPA compliance and additional Canadian coordination will be required before implementation could occur.

Link to RPA's - NMFS BIOP Section 9.6.1.2.3 Page 63, **Action 19** and Section 9.6.1.2.3 Page 9-66, **Action 22.** USFWS BIOP Section 8.1.b Page 73, Action-f2. VARQ shall be implemented (Corps 1999d) as a flood control operations strategy by October 1, 2001, and upon completion of coordination with appropriate Canadian Entities.

Major Activities and Milestones - A process is currently underway within the Corps and with other action agencies to address funding, scoping, and scheduling of the activities such as NEPA compliance and coordination required for implementation of VARQ flood control/storage at Libby Dam.

BOR water for unauthorized irrigation (USBR)

Banks lake 10' draft (USBR)

Following will be covered here:
(NMFS BiOp @ Section 9.6.1.2.6 Page 9-70, Action 31)

Dworshak draft to 1,500 adult evaluation

An evaluation of the potential benefits to adult Snake River steelhead and fall chinook salmon passage by drafting Dworshak to 1,500 feet in September. Also an evaluation of temperature and adult migration will accompany a draft of Dworshak reservoir substantially below 1,520 feet. (NMFS BiOp @ Section 9.6.1.2.6 Page 9-71, Action 34)

System flood control

Following will be covered here:
(NMFS BiOp @ Section 9.6.1.2.6 Page 9-72, Action 35)
(NMFS BiOp @ Section 9.6.1.2.6 Page 9-73, Action 36)
(USFWS BiOp @ Section 8.1.h Page 76, Action-f 8)
(USFWS BiOp @ Section 8.1.i Page 76, Action-f 9)

Libby fall draft

Upper Snake (USBR)

Reclamation water conservation improvements (USBR)

Emergency preparedness

Albeni Falls - In the fall/winter of 2001, Albeni Falls shall be drafted to elevation 2051 feet. In the fall/winter 2002 Albeni Falls shall be maintained at elevation 2,055 feet until fry emerge from shoreline gravels. (NMFS BiOp @ Section 9.6.1.2.3 Page 9-64, Action 19) (USFWS BiOp @ Section 10.A.1.4 Page 89, Action-f 45) (USFWS BiOp @ Section 11.A..1.4.a Page 94, Action-f 65).

The action agencies, the Service, and IDFG shall meet annually to evaluate Lake Pend Oreille kokanee monitoring results and make necessary adjustments through subsequent in-season management. (USFWS BiOp @ Section 11.A..1.4.d Page 94, Action-f 68)

Libby Operations for white sturgeon and bull trout

Storage for Sturgeon Flow - When VARQ at Libby is implemented water shall be stored in Libby reservoir and supply, at a minimum, water volumes during May, June, and July based upon a water availability or "tiered" approach as defined and summarized the table below 10 (below). This water shall be in addition to storage needs for listed bull trout, salmon, and the 4,000 cfs minimum releases from Libby Dam. Accounting on these total tiered volumes shall begin when the Service determines benefits to conservation of sturgeon are most likely to occur. This may include releases timed to enhance survival of eggs, yolk sac larvae, or larvae reared under the preservation stocking program and released into the Kootenai River. Releases may be timed to serve both wild fish and hatchery eggs/fish. Sturgeon flows will generally be initiated between mid-May and the end of June to augment lower basin runoff entering the Kootenai River below Libby Dam. The following volumes are for planning purposes only. Final minimum tiered sturgeon volumes shall be based on further studies involving May, June, and July volumes and daily modeling. Final tiered sturgeon volumes shall be defined and modeled in coordination with the Service by October 2001. (USFWS BiOp @ Section 8.1.d Page 74, Action-f 4)

Possible minimum "tiered" volumes of water to be stored for sturgeon flow enhancement based upon the April - August volume runoff forecast above Libby Dam.

Forecast runoff Volume (maf) at Libby	Tier	Sturgeon Flow (maf) from Libby Dam
0.00 < forecast < 4.80	1	Sturgeon flows not requested
4.80 < forecast < 6.00	2	0.80
6.00 < forecast < 6.70	3	1.12
6.70 < forecast < 8.10	4	1.20
8.10 < forecast < 8.90	5	1.20
8.90 < forecast	6	1.60

Retention of July/August water in Lake Koocanusa under A Libby-Arrow water exchange, in order to reduce the second peak flow created by July/August salmon flow through Kootenay Lake July and August. An agreement to will be sought by October 2001. (USFWS BiOp @ Section 8.1.e Page 75, Action-f 5)

Increased Flow Capacity at Libby (NWS) - At least 10,000 cfs of increased release capacity at Libby Dam will be provided in two increments of at least 5,000 cfs each under the following conditions, sequence, and schedule by spring 2002, the existing spillway will be used routinely for sturgeon flow augmentation within the constraints determined above in Section 6.5.1.10.1. (USFWS BiOp @ Section 8.2.a.3 Page 78, Action-f 12)

This spillway option shall only be considered a viable long-term conservation measure if VARQ, or a comparable flood control/storage procedure, is in effect which assures the reservoir surface routinely (in all but the greatest 20th percentile of water years, for April-August runoff) exceeds the spillway elevation by the time sturgeon flows are needed. The timing of spillway use shall be determined in part by the ability to maintain 10 degrees Celsius at Bonners Ferry with the selective withdrawal facilities at Libby Dam. (USFWS BiOp @ Section 8.2.a.4 Page 78, Action-f 13)

If by December 30, 2001, it is determined that at least 5,000 cfs can not be routinely passed over the spillway within the total dissolved gas criteria of 110 percent, or VARQ or some other flood control/storage procedure has not been adopted, preparation of NEPA documentation immediately begin and funding for installation of one turbine or spillway flow deflectors, which are to be operational by spring 2004 will be sought. (USFWS BiOp @ Section 8.2.a.5 Page 79, Action-f 14)

By spring 2007, means will be sought to release an additional 5,000 cfs (total of at least 10,000 cfs) at Libby Dam for sturgeon conservation. (USFWS BiOp @ Section 8.2.a.6 Page 79, Action-f 15)

Consultation will be reinitiated with the Service if at any point it is determined either of the above two 5,000 cfs (10,000 cfs total) increased release increments scheduled for spring of 2002, or 2004 and 2007, is not achievable. (USFWS BiOp @ Section 8.2.a.7 Page 79, Action-f 16)

Flood levels and public safety concerns along the banks of the Kootenai River below Libby Dam will be evaluated by spring 2001, the COE will evaluate, and the feasibility of increasing releases above any identified channel capacity constraints through structural or non-structural means. A report shall be provided to the Service by December 1, 2001. (USFWS BiOp @ Section 8.3.a. Page 80, Action-f 22)

Redundancy in transformers at Libby Dam shall be sought to assure that sturgeon flows can be released. (USFWS BiOp @ Section 8.2.d. Page 80, Action-f 21)

Means shall be sought to restore, maintain, or enhance levees throughout the Kootenai Valley to the greater of: (1) the PL 84-99 Corps = 1961 levee specifications, or (2) the levee elevations needed to contain the flows/river stages of the 100 year event as authorized for the Libby Project, which is now defined as 1,770 feet at Bonners Ferry. (USFWS BiOp @ Section 8.3.b. Page 80, Action-f 23)

Kootenai River Investigation - The report of the proposed Kootenai River channel capacity investigation will include or append all site specific elevation data gathered on structures which

could be impacted and data on the defined 100 year floodplain. Should the evaluations of channel capacity study determine that structural floodplain encroachment may constrain the increased release capacities at Libby Dam (specified herein, up to 35,000 cfs at Libby Dam), the December 30, 2001 report will also include any remedies necessary to restore this channel capacity, the means available to effect those remedies, and a schedule to do so. (USFWS BiOp @ Section 8.2.a.2 Page 78, Action-f 11)

The effects of groundwater seepage associated with the magnitude and duration of sturgeon flows on crops in the Kootenai Valley will be quantified relative to all other types high flow/stage events which occur in the Kootenai River. The effects of direct precipitation and runoff from small tributaries within the Kootenai Valley on both surface and ground water levels will also be accounted for in this study. This will include delineation of specific sites affected and identification of all feasible remedies specific to those sites such as, drainage, willing seller land purchases, and enrollment in the Department of Agriculture's Wetland Reserve Program. (USFWS BiOp @ Section 8.3.c. Page 81, Action-f 24)

The action agencies report will be prepared on the effects of load following on levee integrity throughout the Kootenai Valley over the last 26 years. This may be incorporated into the ongoing flood damage reduction study. (USFWS BiOp @ Section 8.3.e. Page 81, Action-f 26)

IV. Water Quality

Overview

The ecological objectives of the Endangered Species Act and the Clean Water Act impose requirements on the operation of the FCRPS hydrosystem. There are primarily two water quality elements the impact water management decisions: water temperature and total dissolved gas (TDG) levels.

The 2000 NMFS Biological Opinion calls for the development of an annual water quality improvement plan (RPA 5). The plan is to describe the objectives, priorities and decision criteria for the measures in the plan, and for the one and five year (annual) implementation plans. The body of the specific water quality measures are contained in RPA's 130 through 143. In Appendix B of the Biological Opinion, there is a discussion of the development of a more general water quality plan. This plan is broader than the NMFS Biological Opinion's Water Quality Plan, and would include measures to further Clean Water Act objectives which are not necessarily related to avoiding jeopardy to listed species under the ESA.

The Water Quality RPAs can generally be divided into two categories, those for total dissolved gas (130-140), and those for water temperature (141-143.) The long-term goal for TDG is to reach the 110 percent TDG standard in all designated critical habitat in the Columbia and Snake Rivers within 10-15 years (B.O. at 9-21.) Similarly, the long-term goal for water temperature is attainment of water temperature standards in all designated critical habitat in the Columbia and Snake Rivers. To ensure progress toward these long-term goals, NMFS advised the action agencies to work with NMFS, USFWS, EPA, the Columbia River Tribes, and the states of Washington, Oregon, Idaho and Montana through an adaptive management process to develop the broader water quality plan described in Appendix B.

The TDG Water Quality RPAs can be further broken down into the following categories. RPAs 130 through 133 concern the completion of the DGAS study, and actions to enhance the action agencies' ability to monitor and model dissolved gases within the FCRPS system. RPAs 134 through 140 involve actions to evaluate and implement, when warranted, structural changes within the FCRPS system (spillway deflectors, divider walls, addition of turbines, removable spillway weirs, or other TDG abatement options) to reduce TDG on a systemic and individual project basis. RPA 141 calls for the evaluation of temperature impacts on juvenile fish during critical migration periods, RPA 142, the development of measures to address juvenile mortality associated with high summer temperatures at McNary Dam, and RPA 143, the development of a plan to model water temperature effects of alternative Snake River operations.

In the Biological Opinion Appendix F, RPAs 132, 136, and 143 have been identified as key three-year checkpoint items. RPA 132 is a systematic review and evaluation of TDG fixed monitoring station in the forebays of all the mainstem Columbia and Snake River dams. This includes refining the location of fixed monitoring sites, as warranted, in coordination with the Water Quality Team. This action is already underway, and a subcommittee of the Water Quality Team has already been formed and met several times to address this issue. RPA 136 is the design and construction of spillway deflectors at Chief Joseph Dam (to reduce TDG). RPA 143

is the development of a plan to model the temperature effects of alternative Snake River operations. The remainder of the RPAs , 130-143, will have status checks during the three year evaluation. In recognition of NMFS expressed emphasis on RPAs 132, 136, and 143, the action agencies will prioritize these action items.

A number of actions to reduce TDG are already scheduled for implementation. Specifically, flow deflectors are scheduled to be constructed at McNary (4 deflectors by Spring 2002), at Bonneville (6 deflectors by Spring 2002), Lower Monumental (2 deflectors by Spring 2003), Little Goose (2 deflectors by 2004) and at Chief Joseph (19 by 2004.) An evaluation of a full complement of deflectors at The Dalles is scheduled to be completed by 2005. The COE is also attempting to expedite construction projects for a removable spillway weir at Lower Granite and a stilling basin repair project at Lower Monumental. All of these projects are expected to lower TDG levels within the mainstem.

The DGAS study has been published for review and is expected to be finalized by the end of September 2001. The final report may contain additional TDG reduction projects. TDG monitoring is already being implemented throughout the mainstem, and as mentioned above, a systematic review to improve reliability and accuracy of the fixed monitoring stations is already occurring in the Water Quality Team subcommittee. The COE has also made recommendations to the Water Quality Team concerning a system-wide TDG model (Mass I and Mass 2). Concerning temperature, the Waterway Experiment Station (COE national science center) has already provided a cost estimate for a plan to model temperature effects of alternative Snake River Operations, and discussions between BPA, the COE, and EPA regarding how this should be accomplished have been initiated. The action agencies will continue to manage storage reservoirs (particularly Dworshak) to retain and release cooler water for the benefit of listed fish throughout the in-season.

A general priority the Action Agencies will consider is to develop spill patterns that reduce TDG to the 110 percent standard while still meeting the survival objectives of listed species. As a part of this consideration, the action agencies will identify those ESUs most at risk, and implement TDG and temperature reduction actions in those geographic areas that would most benefit these highest risk ESUs. A secondary consideration will be to evaluate the sensitivity of the ESUs (and individual listed species) to TDG and temperature, e.g. are the affected fish, due to their life stage or other critical biological criteria, especially susceptible to higher TDG or temperature levels.

At the lower eight Columbia and Snake river mainstem hydro projects, spill will be reduced as necessary to meet state and Tribal water quality variances. 9-121 At the same time, the action agencies will, to the extent feasible, increase allowable spill discharge up to the TDG gas caps to increase juvenile fish passage during voluntary spill periods. 9-124

Considering both juvenile and adult fish passage criteria, the action agencies will attempt to develop spill patterns that improve juvenile survival, reduce delay of juvenile salmon in dam forebays, optimize juvenile egress from tailraces, and provide for adult passage conditions downstream of fish ladder entrances. 9-124

The action agencies will also prioritize efforts to improve TDG monitoring, by improving QA/AC components, including redundant and backup monitors, and consider alteration of sampling locations to provide more representative measure of TDG in the water mass. 9-123 and 9-124

The TDG monitors will monitor, at a minimum, smolt populations at selected locations, and adult listed fish at Bonneville and Lower Granite dams. 9-123

In many respects, the RPAs, due to their specificity, help to define the priorities the Action Agencies will use to address water quality. The TDG study will help to resolve critical uncertainties regarding how dissolved gases affect salmonids, and will assist with in-season management of voluntary and involuntary spill. Studying and modeling water temperature impact upon salmonids will help inform decisionmakers when to hold and release cooler storage reservoir water to maximize benefits to listed species. Improved monitoring will help determine the effects of operational and structural changes which can made within the system, measure the effects of those actions once they are implemented, and provide a basis for adaptive management and accountability.

Generally, for the greater duration of the Biological Opinion, the Action Agencies will apply the criteria developed in the science rationale in section 3 of the implementation plan, and will adapt water quality actions to meet performance standards as they are further developed. In this initial stage of implementation, for at least FY 2001 and 2002, however, the action actions are constrained by existing funding limitations. It should be noted that many of the Water Quality RPAs are already (partially) funded, or scheduled to be funded over the next two years including RPAs 131, 132, 133, 134, 135, 138, 141, 142, and 143. These actions are described in greater detail in the Hydro table and the Configuration Project Management Plans. .

The long-term water quality goal is to achieve the 110 percent TDG standard while still meeting the survival objectives of listed salmon. However, in the near-term, as noted in the paragraph above, actions will be taken to operate the FCRPS in a manner that keeps the TDG below the interim standards described in the BiOp.

Water Quality Work Plans

Work plans for water quality projects (other than the configuration spill way modification projects which are intended to reduce dissolved gas levels) have not yet been prepared. As the Water Quality Plans are completed and specific projects are identified work plans will be completed and included within this appendix.

References:

One-Year Total Dissolved Gas Management Plan – "Draft"
One-Year Water Quality Plan – "Draft"
Five-Year Water Quality Plan - Outline

DRAFT

NMFS Biological Opinion One-Year Total Dissolved Gas Management Plan
(04/04/01)

1. Introduction.

According to the Reasonable and Prudent Alternative measures in the 2000 National Marine Fisheries Service (NMFS) Biological Opinion (RPA 9.4.2.4), a 1-year water quality plan for operation and configuration measures at Federal Columbia River Power System (FCRPS) projects is necessary. The advance planning process is critical to achieving FCRPS hydro performance standards within the time-frame of the Biological Opinion (BiOp). This document is the 2001 Total Dissolved Gas (TDG) management plan called for in 9.6.1.7.2 (Action 131), Current and Near-term Actions and Studies, and is to be included in the NMFS Regional Forum Technical Management Team (TMT) Water Management Plan for 2001. It includes a description of TDG and water temperature monitoring program directed in Action 131. This document also describes quality assurance and quality control components, redundant and backup monitor status, calibration of monitoring equipment procedures, spot-check monitoring procedures, error checking procedures, data correction procedures, database storage management, and daily reporting procedures. In addition, this document describes a plan to conduct a systematic review and evaluation of the TDG fixed monitoring sites in the forebays of all the mainstem Columbia and Snake river dams, as directed in Action 132. Also included is a description of the SYSTDG spreadsheet model and the MASS1 one-dimensional model to be used in 2001, as directed in Action 133. The framework for the 5-year water quality plan, as described in 9.4.2.4, Water Quality Plan, is also a part of this plan. However, because this submittal is a transition year, only a framework is included. The 5-year plan is being fully developed and will be released later in 2001.

Information in this annual plan that is not required by the 2000 BiOp includes TDG and water temperature components that are operational considerations important for TMT decision-making. They include: spill requirements, management options, 2001 runoff conditions, a 2001 TDG management plan, and a 2001spill priority.

Summer operations for water temperature control at Lower Granite Dam on the lower Snake River, as directed in 9.6.1.2.3, FCRPS Reservoir Operations to Support Mainstem Objectives, Action 19, are discussed in the TMT Water Management Plan.

2. TDG and Water Temperature Monitoring Program.

This section meets the requirements of RPA Action 131. The 2001 water year is a transition year between the 1995 and 1998 supplement BiOp requirements to the new 2000 BiOp requirements.

Figure 1. 2000 Dissolved Gas Monitoring Network

Total Dissolved Gas (TDG) and water temperature are monitored throughout the Columbia River basin using fixed monitoring stations (FMSs). There are a total of 41 FMSs in the United States portion of the Columbia River basin. The Corps of Engineers operates 29 of the FMSs. It should be noted that the Corps dam on the Kootenai River (Libby Dam) is part of the fixed monitoring station program only during high runoff years when spill could occur at those projects. Figure 1 contains a 2000 map of the fixed monitoring stations of each of the Corps FMSs, including fixed monitoring sites of the Bureau of Reclamation, Douglas County PUD, Chelan County PUD, and Grant County PUD. The 2001 fixed monitoring sites remain the same as the 2000 sites shown on Figure 1.

The Bureau of Reclamation, Douglas County PUD, Chelan County PUD, and Grant County PUD's maintain a cooperative effort with the Corps in collecting and reporting total dissolved gas and related water quality parameters and in making this information available to the Corps for storage in their CROHMS database. The Bureau of Reclamation maintains fixed monitoring stations at Grand Coulee and Hungry Horse Dams. Monitoring stations at Rocky Reach and Rock Island Dams are maintained by Chelan County PUD; stations at Wanapum and Priest Rapids Dams are maintained by Grant county PUD. Douglas County PUD provides water quality data for Wells Dam.

3. Quality Assurance/Quality Control.

This section meets the requirements of RPA Action 131.The 2001 water year is a transition year between the 1995 and 1998 supplement BiOp requirements to the new 2000 BiOp requirements.

The quality assurance/quality control procedures for 2001 were determined by each Corps District. The Portland and Seattle district procedures are similar, but not the same.

A report on the quality assurance of the 2000 TDG and water temperature data collected for eight Portland District stations on the lower Columbia River from the upstream location of the John Day forebay to the downstream location of Camas, 24.5 miles below Bonneville Dam, was prepared by the US Geological Survey and is available as Water-Resources Investigations Report 01-4005. The report included data collection methods, instrumentation calibration, daily quality assurance checks, summary of data completeness, and site specific considerations. Data collection for 2001 will be similar to the 2000 program.

A report on the quality assurance of the 2000 TDG and water temperature data collected for 18 Walla Walla District stations on the lower Snake and Clearwater rivers, and on the mid-Columbia River was prepared by the Walla Walla District and is available. The report included data collection methods, instrumentation calibration, daily quality assurance checks, summary of data completeness, and site specific considerations. Data collection for 2001 will be similar to the 2000 program.

Quality assurance measures at the three Seattle District FMSs are maintained, two by their contractor and one by the district.

The Portland, Seattle, and Walla Walla districts and the Northwestern Division have begun discussions to adopt consistent quality assurance/quality control procedures. To date, discussions were held on February 6, 2001 and a meeting was held in Walla Walla on March 1, 2001. Some consistent procedures are expected to be implemented in 2001, with a plan for full consistence to be developed in 2001, and full implementation in 2002.

4. Redundant and Back-up Monitoring.

This section meets the requirements of RPA Action 131. The 2001 water year is a transition year between the former BiOp requirements to the new BiOp requirements.

Discussion of the implementation of redundant and back-up monitoring began on February 16, 2001. This topic will be a major consideration at the Corps meeting in Walla Walla on March 1, 2001. Redundant monitoring has been attempted by the Walla Walla District in the past. There were several technical problems in implementing redundant monitoring and the maintenance costs were high. Redundant monitoring will be re-evaluated.

All Districts are re-evaluating their 2001 budget flexibility and a back-up monitoring plan will be discussed and developed at the March 1, 2001 meeting in Walla Walla.

5. Calibration of Monitoring Equipment Procedures.

This section meets the requirements of RPA Action 131. The 2001 water year is a transition year between the former BiOp requirements to the new BiOp requirements.

The calibration procedures for 2001 were determined by each Corps District. The Portland and Seattle district procedures are similar, but not the same.

Calibration of instruments for the Portland District sites are discussed in a 2000 report prepared by the US Geological Survey and is available as Water-Resources Investigations Report 01-4005. Calibration of the 2001 sites will be mostly repeated, with some possible changes as a result of the March 1, 2001 meeting in Walla Walla.

Calibration of the Walla Walla district sites will be mostly similar to the 2000 calibration procedures, with some possible changes as a result of the March 1, 2001 meeting in Walla Walla.

Seattle District sites will be mostly calibrated to the 2000 calibration procedures, with some possible changes as a result of the March 1, 2001 meeting in Walla Walla.

6. Spot-check Monitoring Procedures.

This section meets the requirements of RPA Action 131. The 2001 water year is a transition year between the former BiOp requirements to the new BiOp requirements.

Spot-check monitoring procedures for 2001 will be developed for all of the district FMSs at the March 1, 2001 meeting in Walla Walla. Discussion with the NMFS Regional Forum WQT about this topic will occur.

7. Error Checking Procedures.

This section meets the requirements of RPA Action 131. The 2001 water year is a transition year between the former BiOp requirements to the new BiOp requirements.

Measurement errors can arise from many sources in the field and in filing and storing information in a database. There are field procedures to check for errors and there are data analysis procedures for checking for errors.

This section deals with the field errors. The data analysis procedures for checking satellite transmission errors are discussed in 8. Data Correction Procedures.

There is error associated with every measurement, and the value of the error is called uncertainty. The uncertainty of any measurement is a combination of precision and bias. Precision uncertainty is introduced in any repeated measurement due to the variability of an instrument. Calibration of the instrument will affect bias uncertainty.

A description of the 2000 instrumentation and the calibration procedures for the Portland District are described in a 2000 report prepared by the US Geological Survey and is available as Water-Resources Investigations Report 01-4005. Calibration of the 2001 sites will be mostly repeated, with some possible changes as a result of the March 1, 2001 meeting in Walla Walla. Data that are determined to be in error, along with a correction factor, are reported to the Northwestern Division Water Quality Team. The data correction will then be made to the historic database, without changing the CROHMS database.

Calibration of the Walla Walla district sites will be mostly similar to the 2000 calibration procedures, with some possible changes as a result of the March 1, 2001 meeting in Walla Walla. Data that are determined to be in error, along with a correction factor, will be reported to the Northwestern Division Water Quality Team. The data correction will then be made to the historic database, without changing the CROHMS database.

Seattle District sites will be mostly calibrated to the 2000 calibration procedures, with some possible changes as a result of the March 1, 2001 meeting in Walla Walla. Data that are determined to be in error, along with a correction factor, are reported to the Northwestern Division Water Quality Team. The data correction will then be made to the historic database, without changing the CROHMS database.

8. Data Correction Procedures.

This section meets the requirements of RPA Action 131. The 2001 water year is a transition year between the former BiOp requirements to the new BiOp requirements.

Corrections to the 2001 field data received from the FMSs at the Northwestern Division will be made throughout the season. The corrections will not be available in real-time for operational decision-making but will be reflected in the historical reports on the TMT webpage.

Corrections, in this context, mean that data values will be changed if the changes are provided by the district or district representatives in the form of instrument shifts or data shifts.

Data will be removed from the database when there has been a satellite transmission error, or field instrumentation criteria exceed the following:

- The barometric pressure data is <700 or >800 mm Hg;
- The TDG pressure data is <700 or >1100 mm Hg;
- Water temperature data is >75º F.

In cases when mid-summer high atmospheric air temperatures dominate the region, water temperatures over 70º F will be evaluated closely, with verification from the field, if necessary.

9. Database Storage Management.

This section meets the requirements of RPA Action 131. The 2001 water year is a transition year between the former BiOp requirements to the new BiOp requirements.

Real-time data will be stored in the Columbia River Operational Hydromet System. Historic data, which will include both the originally transmitted and the corrected data, will be available on the TMT homepage.

The Corps has initiated an inter-agency meeting with Region 10, Environmental Protection Agency representatives, US Bureau of Reclamation, and Bonneville Power Administration representatives scheduled for March 14, 2001 to discuss the need for a regional water quality database for future TMDL efforts. Long-term database storage management related to time series data for 2001 and the future will be discussed.

10. Daily Reporting Procedures.

This section meets the requirements of RPA Action 131. The 2001 water year is a transition year between the former BiOp requirements to the new BiOp requirements.

Hourly data will be available for all of the Corps FMSs on the TMT homepage, as in previous years. No changes are scheduled for 2001.

11. Fixed Monitoring Site Evaluations.

This section meets the requirements of RPA Action 132. The 2001 water year is a transition year between the former BiOp requirements to the new BiOp requirements.

The Corps has initiated a program to evaluate all its FMSs. Discussion of a systematic evaluation of the FMSs in 2001 between the Northwestern Division and its three districts began on February 16, 2001. This topic will be a major consideration at the Corps meeting in Walla Walla on March 1, 2001. An evaluation schedule will be developed, with coordination with the NMFS Water Quality Team (WQT).

Additionally, a WQT subcommittee has been established to discuss FMSs, especially their ability to measure the representative conditions of the flow passing each individual location. Preliminary discussions among WQT members, including the Corps representative, have been underway in February 2001. The first meeting of the subcommittee is scheduled for February 23, 2001.

12. Spill Requirements.

The definition of voluntary spill used in the region is variable. Some public agencies define all water release over the dam spillways to achieve a spill cap as voluntary spill. Other agencies indicate that if there is a lack of an electric power market when spill is occurring, voluntary spill is the difference between the spill for fish and the amount ascribed to the lack of market load.

The amount of water ascribed to the lack of market is defined by some as involuntary spill. Involuntary spill is also caused when above average flows exceed the hydraulic capacity of the power generation facilities.

Isolated instances of involuntary spill caused by power market conditions are likely to occur.

The planning dates for the annual spill program are April 3 to June 20 and June 21 to August 31 for the spring and summer migration period, respectively, in the Snake River. The planning dates for the lower Columbia River are April 10 to June 30 and July 1 to August 31 for the spring and summer migration periods. A summary of the general guidance on the spill requirements and other considerations, described in the 2000 BiOp in 9.6.1.4.4, Project-by-project Spill Requirements, Table 9.6-3, page 9-89, is listed in Table 1.

Table 1

PROJECT[1]	ESTIMATED SPILL LEVEL[2] (kcfs)	HOURS	LIMITING FACTORS
Lower Granite	60	6 PM - 6 AM	gas cap
Little Goose	45	6 PM - 6 AM	gas cap
Lower Monumental	40	24 hours	gas cap
Ice Harbor	100 (night) 45 (day)	24 hours	nighttime - gas cap daytime - adult passage
McNary	120 - 150	6 PM - 6 AM	gas cap
John Day	85-160/60%[3] night	6 PM - 6 AM[4]	gas cap / percentage
The Dalles	40% of instant flow	24 hours	Tailrace flow pattern and survival concerns (ongoing studies)
Bonneville	90 - 150 (night) 75 (day)	24 hours	nighttime - gas cap daytime - adult fallback

The specific spill volumes must be viewed as approximate because TDG levels measures at a monitoring site below each of the projects, at a given spill level, can vary with factors such as river flow, forebay dissolved gas levels, spill pattern, and water temperature changes. There are also project-specific limitations on spill levels for reasons other than TDG, including adult fish passage, navigation, and research activities. These limitations are typically of short duration, but they can affect spill for fish passage to a limited degree.

[1] Summer spill is curtailed beginning on or about June 20 at the four transport projects (LGW,LGS,LMN, and MCN) due to concerns about low in-river survival rates.
[2] Estimated spill level will increase for some projects as spillway deflector optimization measures are implemented.
[3] JDA cap is estimated at 85 to 160 kcfs; trailrace hydraulics spill cap is 60%. Up to 300 kcfs, spill will be 60% of instantaneous project flow. Above 300 kcfs, spill discharges will be at the gas cap (up to the hydraulic limit of the powerhouse).
[4] JDA spill will be: 7 PM to 6 AM (night) and 6 AM to 7 PM (day) between May 15 and July 31.

13. Management Options.

Spill for fish passage is made by adjusting the volume of water passing over the spillways to keep TDG per cent of saturation within a designated maximum percent called a spill cap at a fixed monitoring site (FMS). The Water Quality Team of the Northwestern Division, Corps of Engineers Reservoir Control Center is responsible for monitoring the TDG and water temperature conditions in the forebays and tailwaters of each of the eight lower Columbia River/lower Snake River dams, and other Corps sites such as Chief Joseph Dam on the mid-Columbia River and Dworshak Dam on the North Fork Clearwater River. The operational water management guidelines are to change spill volumes at the dams (daily if necessary) so that forebays are operated to a spill cap of 115 per cent TDG and the tailwaters are operated to a spill cap of 120 per cent TDG. It should be recognized that environmental factors and monitoring equipment variability will cause some exceedances. One exception is at Dworshak Dam; the tailwater is operated near to, but below, 110 per cent at the recommendation of the State of Idaho because variances are not provided.

Spill caps are assigned to each project, and are adjusted daily during in-season based on hourly TDG values reported on the TMT homepage. Spill schedules for each of the Corps projects can be prepared as often as daily.

Management considerations include:

- Amount of water that can be stored behind reservoirs;
- Quantity of spill that can be shifted to various periods within a day;
- Volume of water that can be used for hydroelectric generation;
- Ability to shift spill within the system to avoid excessive local conditions;
- Amount of spill that can be transferred outside the system; and
- More efficient use of the spill bays.

Changing spill from a crown to a uniform pattern, avoiding the use of spillbays without deflectors, and allowing turbine units to operate outside their 1% peak efficiency flow range are additional management options. Scheduling of service and maintenance times, identifying additional energy loads, and displacing available thermal projects also serving the same loads also help to relieve the need for spill during some hydrologic conditions.

To maintain uniform TDG conditions or to avoid spill in river reaches where the greatest number of fish are actively migrating, spill may be distributed to other projects in a planned sequence. Staring with projects with the least propensity for developing high TDG levels or those located outside the fish migration corridor. A spill priority list is established to control which projects start spill, and to control the amount of water they are allowed to spill.

In general, spill occurs at projects with assigned fish-passage levels. Additional spill is distributed to other projects in the system as shown in Figures 2 and 3.

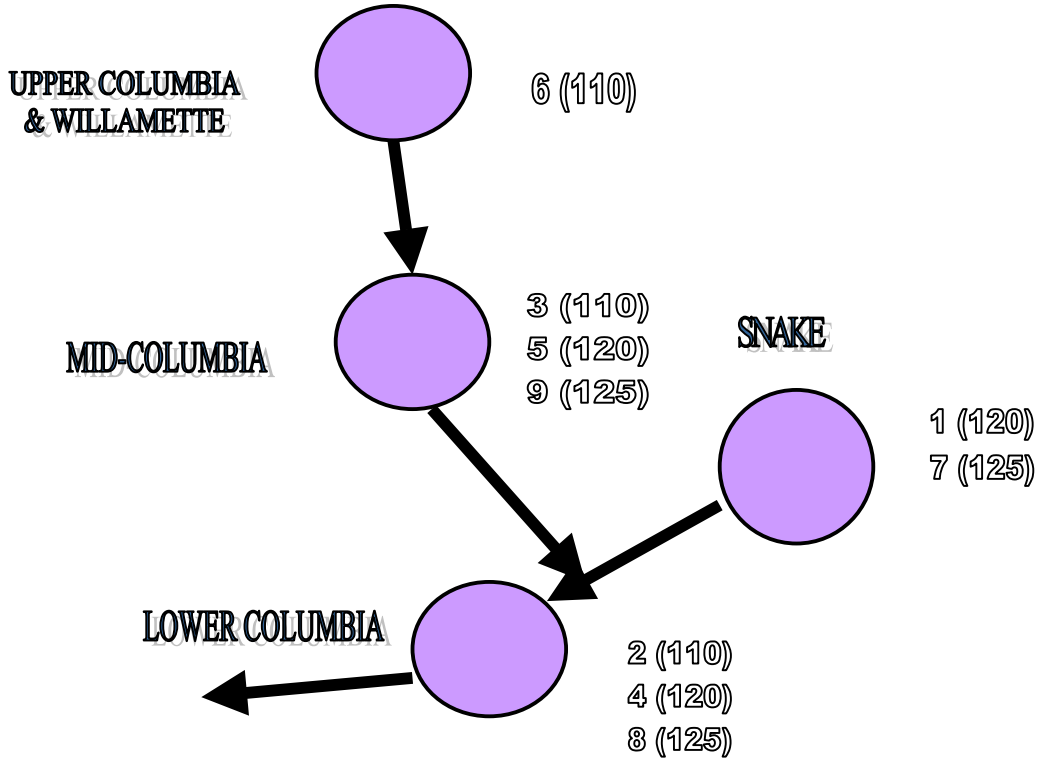

FIGURE 2
SPILL PRIORITY FOR APRIL 3 - APRIL 20
Priority (% TDG)

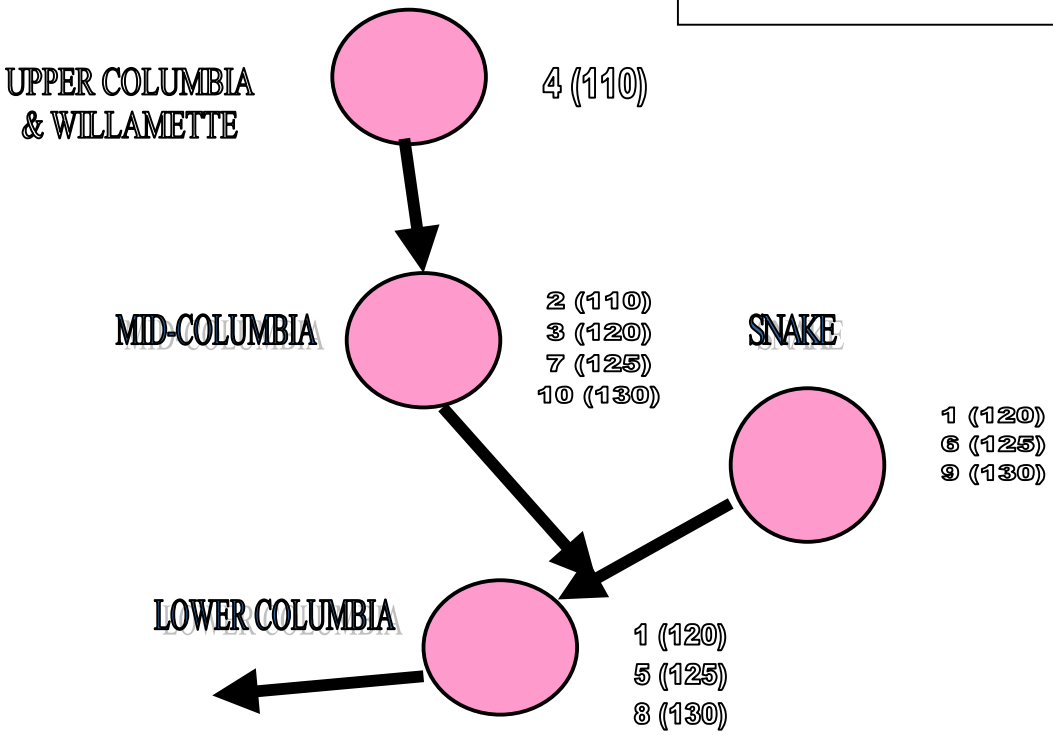

FIGURE 3. SPILL PRIORITY FOR APRIL 14-AUGUST 31
Priority (% TDG)

Two periods are show; April3 to April 20 (voluntary spill at lower Snake River projects only) and April 20 to August 31 (voluntary spill at both the lower Snake and lower Columbia River projects). The TMT can recommend adjustments to the spill priority based on real-time TDG and fish migration conditions and/or other relevant conditions.

13. 2001 Runoff Conditions.

The January - July runoff volume forecasts (as of mid-February 2001) indicate that 2001 will be a drought runoff year with 63,280 million acre-feet (MAF) or 61 percent of normal at Grand Coulee and a drought runoff year with 29,740 MAF (59 percent of normal) at Lower Granite, and a drought runoff year with 105,900 MAF at The Dalles (59 percent of normal). As a result, it is anticipated that limited spill, both voluntary and involuntary, will prevail throughout the system.

14. 2001 TDG Management Plan.

The 2001 TDG Management Plan approach is similar to 2000. Storage reservoirs will be operated to flood control rule curves as much as possible during the drought period and there are projects that can provide some flexibility to minimize incidents of involuntary spill. Spillway flows will be regulated to the 115/120 per cent ESA spill caps (110 percent in Idaho) as long as possible without jeopardizing flood control objectives. If TDG cannot be managed near to, or below the 115/120 (110 percent in Idaho) percents because of unusually high runoff events, the river spill will be managed in the best interest of listed and proposed salmon stocks. It is recognized that measures designed to physically reduce TDG could have significant impact on migrating salmon. Therefore, recommendations from state and tribal entities and the WQT will be sought when using TDG control measures.

The essence of the 2001 TDG Management Plan (Figures 2 and 3), which may by modified in-season by TMT if necessary, is:

- Implement spill for fish passage at all mainstem Federal dams shown in the Table 1, as specified in the 2000 BiOp, to the ESA spill caps of 115/120 per cent (110 percent in Idaho) TDG. Spill will be adjusted as needed, based on real-time TDG data, and in the priority of fish movement then biological conditions..
- Operate units within 1 per cent efficiency.
- Limit daytime spill at Bonneville Dam to avoid adult fallback.
- Accommodate special spill requirements/restrictions for research, adult passage, etc. that have full endorsement of all stakeholders. Also, continue to implement the fish transportation program as agreed to and using calculation method endorsed by NMFS (or an equivalent method agreed to at TMT).
- Implementation of the spill priority outlined in Figures 1 and 2 will be used when system-wide TDG exceeds 120 per cent , using the incremental system TDG control objectives. Spill will start from the lower river and work upstream, unless different priorities are recommended by the TMT.

- Discontinue or postpone field research and non-critical unit service and maintenance schedules that create, or have potential for creating, high localized TDG levels, especially when and where large numbers of fish are present.
- Operate turbines outside their respective 1 percent efficiency flow ranges at projects where measurable reduction in TDG (at least 3 percent, given the accuracy range of the instrumentation) and no intolerable adverse impacts to fish can be expected.
- Store water at lower Snake reservoirs above Minimum Operating Pool level, if this results in a measurable (3 percent or more, based on instrumentation accuracy) reduction in TDG levels.
- Experiment with new and promising spill patterns.
- Implement other operations or measures recommended by the TMT or the IT.(This may include appropriate changes in transportation targets when TDG exceeds levels that are recognized as lethal (130 percent or more for one week or longer, per NMFS) or when obvious in-river lethal conditions exist.

15. 2001 Spill Priority.

The project priority for ESA spill cap levels will be used to attempt to control total dissolved gas (TDG) to 115% in the forebays and 120% in the tailwaters of the mainstem lower Snake River and Columbia River projects. This does not apply to Dworshak Dam since it will be operated to 109%, at the recommendation of the State of Idaho. Projects are listed in a sequential order, placing first priority on spilling at mainstem Columbia projects before spilling at projects outside the fish migration corridor (Hungry Horse or the Willamette projects).

When system-wide TDG is at or below 120%, the Corps will provide the ESA spill for-fish-passage up to the 120% TDG spill caps in the following order:

- Spill up to the 120% TDG spill caps at Bonneville (BON), The Dalles (TDA), John Day (JDA), McNary (MCN), and Ice Harbor (IHR);
- Spill up to the 110% TDG spill caps at projects outside the lower river fish migration corridor: Priest Rapids (PRD), Rocky Reach (RRH), Wells (WEL), Rock Island (RIS), Wanapum (WAN), Chief Joseph (CHJ), Grand Coulee (GCL), in that order. The priority order for the mid-Columbia projects is as recommended for the period beyond 15 April by the Mid-Columbia Coordinating Committee.
- Spill up to the 120% TDG spill caps at projects where State standards waivers have been granted: PRD, RRH, WEL, RIS, and WAN in that order;
- Spill near to the 110% TDG state standards at Dworshak (DWR), Hungry Horse (HGH) and Willamette Projects.

When system-wide TDG is going to exceed 120% TDG, then spill will be managed system-wide to 125%, then to 130% and so on by spilling up to the spill caps indicated for those TDG levels, at lower Columbia, Snake, mid-Columbia, HGH, and Willamette Projects in that order.

Spill caps for various applicable TDG levels are provided below in Table 2. They will be updated, as needed based on real-time TDG information.

Table 2. ESA Spill caps (in kcfs) corresponding to 110-120 % TDG Levels

PROJECT	TDG%	TDG%	TDG%	TDG%	TDG%	TDG%	REMARKS
	110	115	120				
GCL(2)	5 20	5 25	10 30				
BON(1)	70	80	120				
TDA	20	50	130				
JDA	20	50	145				
MCN	20	55	145				
IHR	30	45	95				
LMN							No Spill
LGS							No Spill
CHJ	5	10	15				
LWG							No spill
PRD	20	30	40				
RRH	05	10	20				
WEL	10	15	25				
WAN	10	15	20				
HGH (3)	3	3	3				
HCR	4	4	4				
LOP/DEX	5	5	5				
GPR	2	2	2				
DET/BCL	7	7	7				
TDG %	110	115	120				

1. BON: For flows less than 150 kcfs, spill 75 kcfs. For flows between 200 and 260 kcfs, spill between 50 and 95 kcfs. For flows over 260 kcfs, spill between 90 and 150 kcfs.
2. Assume forebay TDG at 120% (1st row=outlet El<1260'), 2nd row=spillway (El>1260')
3. HGH spill to 3 kcfs (108% TDG) until further notice

16. 2001 Numerical Modeling.

This section meets the requirements of RPA Action 133. The 2001 water year is a transition year between the former BiOp requirements to the new BiOp requirements.

As part of the Corps DGAS study, the Corps has completed three TDG models. Two of them will be used as river operational management tools for 2001.

The Corps developed a one-dimensional spreadsheet model of the lower Snake/Columbia river system for TDG and water temperature called SYSTDG. Two-day workshops sponsored by BPA will be held February 27- 28, 2001 and March 6-7, 2001 on SYSTDG. The workshops will include a variety of technical presentations on TDG processes in the Columbia River Basin and an introduction to the SYSTDG spreadsheet model. An introduction and interactive use of the spreadsheet is the primary objective of the workshop, as developed for the 1996 spill season. Regional participants will receive training and participate in application of computer software. Further development of SYSTDG is anticipated and will be part of the five-year plan.

Since 2001 is developing into a drought year, the Corps will also use the one-dimensional numerical model called MASS1 as an operational management tool.

MASS 1 is a one dimensional, unsteady hydrodynamic and water quality model for river systems. It was developed to be used on branched (tree-like) channel systems and has been extensively applied by Battelle Pacific Northwest Division to the Columbia and Snake rivers. The model simulates cross-sectional average values; only single values of water surface elevation, discharge, velocity, concentration, and temperature are computed at each point in the model, at each time interval.

In the Columbia River Basin, the upper boundaries of the modeled region are the US/Canadian border on the Columbia, Dworshak Dam on the North Fork of the Clearwater River, and Hells Canyon Dam on the Snake River. The downstream boundary is near Astoria, Oregon. Model boundary conditions such as inflows, project operations, and meteorology can be specified on any time interval. Typically project operations are specified on an hourly basis and tributary flows are assigned daily flows or assumed constant.

17. Five-Year Water Quality Plan.

According to the Reasonable and Prudent Alternative measures in the 2000 National Marine Fisheries Service (NMFS) Biological Opinion (RPA 9.4.2.4), a 5-year water quality plan for operation and configuration measures at Federal Columbia River Power System (FCRPS) projects is necessary. The advance planning process is critical to achieving FCRPS hydro performance standards within the time-frame of the Biological Opinion (BiOp).

The objective of the five-year water quality plan is to define and to begin to implement the actions needed to have the FCRPS on the mainstem Columbia River improve the survival rates of Endangered Species Act (ESA) listed species and to comply with the Clean Water Act (CWA) standards by 2015, as described in Appendix B, Water Quality Plan, B.3.1.

The scope of the five-year plan will include the Action Agencies (Corps, BPA, and BOR), in cooperation with EPA, NMFS, and USFWS, developing an interagency Water Quality Plan (AAWQP) by September 2001to analyze factors affecting water temperature and Total Dissolved Gas (TDG) on the mainstem Columbia. The geographic scope of the AAWQP will extend from the international boundary, Dworshak Dam on the North Fork Clearwater, and Brownlee Dam on the lower Snake River, to the tailwater of Bonneville Dam on the lower Columbia River. The TMDL analysis process will be used for water temperature and TDG on the

mainstem Columbia. Other water quality parameters such as dissolved oxygen, nutrients, sediments, and radioactivity will be developed later. The AAWQP will recommend water quality improvement actions to be taken by the Action Agencies, in coordination with the NMFS Regional WQT. The five-year water quality plan will also describe technical processes, procedures, and programs of the water quality efforts; planning studies as described in Tables B-2 and B-3 of the Appendix B of the 2000 BiOp; summaries of the biological effects of the planning alternatives; implementation schedules of selected planning studies; and economic analyses of the planning studies.

Additionally, the Five-Year Water Quality Plan will outline the actions for each of the five years. An annual report for each of the five years will include:

2001 Annual Report:

1. Long-term water quality agreements with States and Tribes;
2. Final AAWQP;
3. Monitoring;
    - Standardization of procedures between Corps Districts;
4. Numerical Modeling;
    - Evaluation of numerical models;
    - Selection of models;
        - Development of modeling plan of action;
5. Review of planning studies in Tables B-2 and B-3 of the 2000 BiOp;
6. Update on the water quality effects of the planning alternatives;
7. Update on the biological effects of the planning alternatives;
8. Update of economic analyses of planning alternatives;
9. Update of implementation schedules of selected planning alternatives;
10. Description of new operational management actions to comply with CWA and ESA;
11. Description of funding of new O&M reservoir control actions taken to meet CWA and ESA.
12. Modifications to the Five-Year Water Quality Plan, including the incorporation of a new fifth year.

2002 Annual Report:

1. Description of TMDL Monitoring;
    a) field data collection;
    b) fixed monitoring sites;
        - representativeness;
    c)data transmission;
        - database management;
            - CROHMS;
            - regional TMDL database;
    d) operational management;
        - reporting;
        - coordination;

2. Numerical Modeling
    a) data collection;
        - hydraulic data;
        - meteorological data;
        - water quality parameters;
    b) model calibration;
3. Description of TMDL coordination with States and Tribes;
4. Review of planning studies in Tables B-2 and B-3 of the 2000 BiOp;
5. Update on the water quality effects of the planning alternatives;
6. Update on the biological effects of the planning alternatives;
7. Update of economic analyses of planning alternatives;
8. Update of implementation schedules of selected planning alternatives;
9. Description of new operational management actions to comply with CWA and ESA;
10. Description of funding of new O&M reservoir control actions taken to meet CWA and ESA.
11. Modifications to the Five-Year Water Quality Plan, including the incorporation of a new fifth year.

2003 Annual Report

1. Description of TMDL Monitoring;
    a) field data collection;
    b) fixed monitoring sites;
        - representativeness;
    c)data transmission;
        - database management;
            - CROHMS;
            - regional TMDL database;
    d) operational management;
        - reporting;
        - coordination;

2. Numerical Modeling;
    a) data collection;
        - hydraulic data;
        - meteorological data;
        - water quality parameters;
    b) model calibration;
    c) model verification;
3. Description of TMDL coordination with State and Tribes;
4. Identification of Water Temperature and TDG improvements in relation to CWA and ESA;
5. Review of planning studies in Tables B-2 and B-3 of the 2000 BiOp;
6. Update on the water quality effects of the most promising planning alternatives;
7. Update on the biological effects of the most promising planning alternatives;
8. Update of economic analyses of most promising planning alternatives;
9. Update of implementation schedules of most promising planning alternatives;

10. Description of new operational management actions to comply with CWA and ESA;
11. Description of funding of new O&M reservoir control actions taken to meet CWA and ESA.
12. Modifications to the Five-Year Water Quality Plan, including the incorporation of a new fifth year.

2004 Annual Report

1. Description of TMDL Monitoring;
    a) field data collection;
    b) fixed monitoring sites;
        - representativeness;
    c)data transmission;
        - database management;
            - CROHMS;
            - regional TMDL database;
    d) operational management;
        - reporting;
        - coordination;

2. Numerical Modeling;
    a) data collection;
        - hydraulic data;
        - meteorological data;
        - water quality parameters;
    b) model calibration;
    c) model verification;
3. Description of TMDL coordination with State and Tribes;
4. Identification of Water Temperature and TDG improvements in relation to CWA and ESA;
5. Review of planning studies in Tables B-2 and B-3 of the 2000 BiOp;
6. Update on the water quality effects of the most promising planning alternatives;
7. Update on the biological effects of the most promising planning alternatives;
8. Update of economic analyses of most promising planning alternatives;
9. Update of implementation schedules of most promising planning alternatives;
10. Description of new operational management actions to comply with CWA and ESA;
11. Description of funding of new O&M reservoir control actions taken to meet CWA and ESA.
12. Modifications to the Five-Year Water Quality Plan, including the incorporation of a new fifth year.

2005 Annual Report

1. Description of TMDL Monitoring;
    a) field data collection;
    b) fixed monitoring sites;
        - representativeness;
    c)data transmission;

- database management;
    - CROHMS;
    - regional TMDL database;

d) operational management;
- reporting;
- coordination;

2. Numerical Modeling;
a) data collection;
- hydraulic data;
- meteorological data;
- water quality parameters;

b) model calibration;
c) model verification;
d) TMDL allocation runs;

3. Description of TMDL coordination with State and Tribes;
4. Identification of Water Temperature and TDG Improvements in relation to CWA and ESA;
5. Review of planning studies in Tables B-2 and B-3 of the 2000 BiOp;
6. Update on the water quality effects of the most promising planning alternatives;
7. Update on the biological effects of the most promising planning alternatives;
8. Update of economic analyses of most promising planning alternatives;
9. Update of implementation schedules of most promising planning alternatives;
10. Description of new operational management actions to comply with CWA and ESA;
11. Description of funding of new O&M reservoir control actions taken to meet CWA and ESA;
12. Evaluation of the Five-Year Water Quality Plan;
13. Development of a One-Year Water Quality Plan for 2006;
14. Development of a new Five-Year Water Quality Plan for 2006 - 2010.

V. Operation and Maintenance

Operations

FCRPS operation priorities are developed annually by the COE in coordination with BPA, the regions fish agencies, Indian tribes, and others. The Fish Passage Plan (FPP) documents agreements that result from these discussions. The FPP covers by individual projects:

- Facility descriptions;
- Seasons and criteria for adult and juvenile fish passage facility operation and maintenance;
- Operating procedures in the event part of a facility malfunctions;
- Spill patterns for adult and juvenile fish passage;
- Turbine unit best efficiency operating ranges and operating priorities;
- Turbine maintenance guidelines;
- Special project operations to support special maintenance activities and research;
- Juvenile fish transportation plan;
- Other information and criteria pertinent to operating the projects for fish passage.

The FPP is updated and coordinated annually through the Fish Passage Operations and Maintenance Coordination Team. The COE releases a draft FPP in early December for regional review. Comments are normally received in January and discussed with FPOM members at a special meeting in late January. Efforts are made to resolve all comments and issues on the FPP prior to issuing the final plan in late February. The COE also addresses comments on the FPP in writing.

The Fish Passage Plan is implemented at COE projects by the Reservoir Control Center (RCC) which coordinates operations at each of the federal dams. Daily RCC briefings occur during flood control and fish passage seasons.

Transmission Capacity Constraints to Operations

The transmission capacity in many areas within of the Federal Columbia River Transmission System (FCRTS) service area is currently fully allocated. Spring river operations (high flows) have a correspondingly high need for transmission capacity to deliver the electricity to often-remote markets. The BiOp identifies two transmission constraints, which at times pose limitations on fish passage operations. The BiOp recommends BPA take actions to expand transmission capacity to enable full implementation of the spill and flow augmentation strategies of the BiOP. Transmission system expansion priorities typically are based upon user demands, financial viability and technical considerations like system reliability. BPA's Transmission Business Line recently announced a number of transmission system expansion projects, several of which will remove spill and flow augmentation obstacles when they are completed. Environmental and land acquisition requirements have lengthened the time required to complete transmission expansion in recent years. New transmission lines require a minimum of 4-years

and many times 5 or more years to complete. Thus, transmission limitations may pose limitations throughout much of the 10-year recovery period of the BiOp.

Maintenance

The COE prepares annual and 5-year maintenance plans for facilities at each of the dams, which includes fish facilities. The maintenance plans describe planned maintenance activities ranging from a daily up to an annual or biannual basis in order to keep equipment operating correctly. Resource or funding limitations in recent years has created a maintenance backlog; hence the current priority has been to reduce the backlog of deferred maintenance.

The BiOp (Action 6) suggests that current maintenance levels need to be enhanced and that the new fish passage facilities will increase maintenance requirements. Action items 144, 145, and 121 also focus on maintenance of juvenile and adult passage facilities, preventative maintenance and the establishment of a spare parts inventory for critical fish passage facilities.

The COE is currently developing long-term preventative maintenance programs that detail life expectancies for major facility components and which schedule overhauls or equipment replacements. This information will be completed in the first 2-years of the 5-year maintenance planning cycle. Development of a spare parts inventory for the projects has also begun. The COE will optimize their maintenance schedule so that maintenance operations minimize impacts on fish migration, spawning, and other critical life-stages.

The Fish Passage Operations and Maintenance Coordination Team (FPOM) has begun to focus on O&M recommendations in the NMFS BO. A reliability based maintenance program, which focuses on uninterrupted operations of critical juvenile and adult passage, facilities (including a spare parts inventory) is being developed for all of the dams. Maintenance programs and budget requirements which result from this effort will be used to formulate budget requests to congress and to BPA who currently direct funds about $23M of FCRPS Fish and Wildlife O&M costs (FY 2001).

Operations and Maintenance Project Management Plans

Project Management Plans for projects that would be implemented by O&M staff and which respond to RPA's contained in the Biological Opinions are enclosed as the following pages. Additional work plans are expected to be prepares when the O&M 5-year plans are finalized. These work plans will be added to this appendix as they are completed.

22. Evaluation of Transportation Strategies

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - Partitioning of mortality throughout the life cycle of salmon and steelhead, and attributing these losses to a specific (dependent) route of passage through the hydrosystem or to a random or an action independent of the hydrosystem is one of the biggest unknowns that have been identified by the analysis of anadromous fish data under the Lower Snake River Feasibility Study. Understanding when, where, and why losses occur will drive the future operation and mitigation actions on the hydrosystem. Information on survival rates of salmon through the hydrosystem is, in general, well known and continues to be evaluated for incremental improvements. However, further downstream and into the oceanic environment delayed mortality or losses are unknown as well as the effects of passage through various routes on these losses. Partitioning losses through these environments will allow for specific transportation strategies to be developed to increased survival.

  Survival downstream of the hydrosystem and through the estuary for in-river migrants and transported fish has been studied for spring/summer chinook. Results from these evaluations, although preliminary, suggest that there are several factors contributing to losses in the estuarine environment. These relate to exposure to avian and picivorous predators, be it through poor barge release locations, and timing to the tidal cycle, flows or season of arrival to the estuary. Understand of the estuarine loss help guide future barging strategies that may increase survival through this area.

  Avian predation continues to be a problem in the estuary. About 30% of the juvenile smolts are estimated to be taken by terns colonizing the dredge spoil islands. This predation rate coupled with new information on estuary migration behavior (i.e., passage routes through shallow grass flats, and holding in the fresh water lens, and ocean entry tied to tidal timing) that suggests increased smolt exposure to predation, suggests that mortality though the estuary may be reduced by providing transportation through this environment.

  Survival of transported fish from the comparative survival study from Lower Granite show a dramatic increase in the rate of adult returns of fish transported later in the season (~mid May) to those transported earlier. The factors contributing to this difference are unknown but understanding the factors (cyclic patterns of oceanic predators versus estuarine losses), contributing to the early season losses may have potential to reduce post-release losses.

  Past research on transportation has focused on juvenile salmon that migrate primarily during the spring and summer, and little to no work has been done to evaluate the effectiveness of transporting late migrants. Late migrants are predominantly fall chinook salmon, with a portion of these ESA-listed Snake River fall chinook. The median date of passage of naturally spawned PIT-tagged Snake River fall chinook salmon past McNary Dam ranges from early to mid August, meaning that half of these fish migrate in late August and into the fall given the protracted smolt outmigration. Beginning in 1992, smolt monitoring and transportation at McNary Dam was extended from October through December, and continues annually. Monthly smolt collections have ranged from a low of 1,838 in October 1998 to a high of 36,520 in November 1997. Of interest is whether these late migrating fish produce any adults at all, and whether the cost of late-season transportation is justified given its unknown benefit. The purported benefits of transportation for fall chinook salmon, such as reduced predation and less exposure to high water temperatures may

not be realized during the fall. Conversely, few operational changes are made to improve in-river conditions for migrants in the fall. It is unknown whether transportation is better than in-river migration during the fall.

- **Description** – Evaluations on the benefits of experimental strategies from Lower Granite for spring/summer chinook and steelhead (and ultimately fall chinook pending information from the comparative evaluation of transportation to inriver survival) for absolute and comparative return rates of smolts transported to smolts that complete their outmigration within the river. Following the recommended changes from the McNary transportation evaluation experimental strategies will be evaluated for spring chinook at McNary. In addition, the effectiveness of late-season transportation from McNary and Lower Monumental Dams will be incorporated in the fall chinook transportation studies. Evaluation of transport requires not only marking of juvenile salmon and the monitoring of returns as adults, but also the physiological assessment of changes in fish condition prior to transport, during and following transport; details on migration behavior following release from the barges; downstream timing, survival data, ocean timing and avian predation monitoring in and downstream of the hydrosystem; and the addition of sample groups in the delayed mortality rearing study.

2. Major Activities/Tasks -

a. Evaluate post-release survival, behavior, migration characteristics and habitat use of juvenile salmon through the estuary, plume and near shore environment. Methodology: radio telemetry, sonic telemetry – using buoyed receiver arrays and series of bottom receivers. (Fall chinook and steelhead 2000-2003)
   - Identify potential trouble areas (delays and losses) and correlate to route of passage, stocks, seasons, and species.
   - Determine differences in delayed mortality caused by difference in post-release behavior and habitat use in the estuary and plume.
   - Determine seasonal differences in post-release mortality (species and stocks).

b. Evaluate barging strategies to reduce mortality. (Pending the result of the steelhead and fall chinook post-release objectives)
   - Determine adult returns of smolts transported and released downstream of Astoria Bridge near the saltwater interface.
   - Evaluate post-release migration behavior, ocean entry timing and timing to the tidal cycle. Monitor with the PIT tag trawler, radio telemetry and sonic telemetry.
   - Develop and compare transportation strategies to increase early season survival.
   - Evaluate fish condition (including stress levels, health, smoltification, energy reserves and changes in nutritional status, including the concentration of macroelements that control osmoregulation), correlate to delayed mortality.

c. Evaluate the effectiveness of late-season transportation at McNary and Lower Monumental Dams.
   - Mark and transport adequate numbers of chinook salmon from October through December at McNary Dam and Lower Monumental to determine adult return contribution.
   - Collect adult return information from marked fish from the Pacific States Marine Fisheries Commission's databases, and determine adult contribution and its relation to time of release.
   - Evaluate fish condition (including stress levels, health, smoltification, energy reserves and changes in nutritional status, including the concentration of macroelements that control osmoregulation), correlate to seasonal changes.

Milestone	Date (Mo/Yr)
Experimental Changes to Barging – LGR start FY03 – Report	March 2006
Experimental changes to Barging – McNary start FY06 Report	March 2009
Adult Monitoring - Through	December 2010
Late Season Effectiveness McNary – start FY02	March 2005
Late Season Effectiveness LMO – start FY04	March 2007

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$730k	$2270k*	$2270k	$2270k	$3300k

* It is important to note that one of the major cost include additional barging services. If work is efficiently designed to use the field crews and efforts for the other transport/inriver survival comparison study there should be cost savings.

4. Issues – Low flows and spill operation, availability of research fish and the timely installation of adult PIT tag detectors at Ice Harbor, McNary and Priest Rapids Dams may delay or compromise the study design. This study requires the use of the PIT trawler and sonic tracking buoyed array.

5. RPA Action.

- **Directly Supports Reasonable and Prudent Alternative:**
  Action 49: "The Corps shall evaluate strategies to enhance post-release survival of transported fish; examples of such strategies include timing releases so that fish arrival at the estuary corresponds to minimal interactions with predators and maximum availability of forage and locating releases so as to decrease passage time through areas of high predation."

- **Supports Elements Under Reasonable and Prudent Alternative:**
  Action 189 - The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies and analyses to evaluate relationships between ocean entry timing and SARs for transported and downstream migrants.

  Action 185 - The Action Agencies shall continue to fund and expand, as appropriate, fish marking and recapturing programs aimed at defining juvenile migrant survival for both transported and nontransported migrants and adult returns for both groups. These studies shall also compare the SARs of transported and nontransported fish to calculate the differential delayed mortality (D), if any, of transported fish.

  Action 186 - The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for comparative evaluations of the **behavior and survival of transported** and downstream migrants to determine whether causes of D can be identified for the reach between Bonneville Dam and the mouth of the Columbia River.

  Action 52 - The Corps shall identify and implement improvements to the transportation program.

Action 47: "During all transport evaluations, the Corps and BPA, in coordination with NMFS through the annual planning process, shall include an evaluation of delayed mortality (D) of transported versus inriver migrating juvenile anadromous salmonids."

Action 195: "The Action Agency shall investigate and partition the causes of mortality below Bonneville Dam after juvenile salmonid passage through the FCRPS." "…include…the extent of delayed mortality, which is uncertain and central to decisions about hydrosystem configuration and the role of juvenile salmonid transportation…."

Action 199: "The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H."

53. Kelt Studies

RPA 109

Draft Multi-Year Plan

12 February 2001

1. Project Information

Purpose/Objective - Adult steelhead that fall back through the juvenile fish bypass facilities have been observed holding in collection channels, de-watering systems and passing through the separators. At this time it is unknown what the impacts of the passage through the juvenile bypass facilities have on the delay and condition of these fish. Unlike chinook, sockeye and coho salmon, steelhead may spawn more than once during their lifetime. In the Columbia Basin, post-spawn steelhead (kelts) must first pass up to nine dams on their return to the ocean. The spawning contribution of kelts to the Snake River steelhead ESU is not currently known. Historically, 2% were thought to be repeat spawners in the Clearwater system (Whitt 1954) and recent estimates of 1.6% have been documented for wild steelhead populations in the Yakima River sub-basin (Hockersmith et al. 1995). Ultrasonic identification and enumeration work conducted in 1999 and 2000 have estimated 80% to 90% of the steelhead passing through the Lower Granite and Little Goose juvenile fish facilities are kelts, but it is not known what proportion or number of them survive through the FCRPS to below Bonneville. By tagging kelts and monitoring their migration downstream through the FCRPS, we could gain a better understanding of routes of passage and survival of kelts. This will provide basic abundance and survival information needed to develop effective protection measures for these fish.

Descriptions - The Corps has been conducting studies with kelts since FY99 with continuing studies occurring in FY01. Initial studies focused on the identification of kelts in an attempt to differentiate them from pre-spawners. Snake River studies have included a radiotelemetry and mark recapture study to determine conversion rates of kelts to downstream dams and the estuary. Studies in the Lower Columbia River have been focused on kelt passage at Bonneville.

Continuing and future studies include: enumerating downstream kelt passage and run timing through the Snake and Columbia rivers; estimating the abundance of kelts in the juvenile facilities in the Snake and Columbia; determination of dam passage routes, distribution and survival estimates; evaluate system survival; monitor fish condition and collect scale samples to determine life history information; and investigating protection measures, including operational changes, collection and downstream transportation, and/or reconditioning studies.

2. Major Activities/Tasks –

Milestone	**Date (Mo/Yr)**
Continuation of Survival Evaluation through Snake River - complete	Mar / 2003
Transportation Studies – start FY 2003 (for three years)	Mar / 2006
Adult Monitoring	Dec / 2007
Reconditioning – BPA?	

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
275,000	**Pending***	**Pending**	**Pending**	**Pending**

* Dependent of the development of the study design and necessary facilities for kelt transport and monitoring.

4. **Issues –** Kelts could serve as an important resource for rebuilding threatened runs of Snake River Steelhead by increasing total number of spawners in future years. Management considerations for kelts include possible transport of intercepted kelts downstream of Bonneville, to reconditioning at hatcheries for a captive broodstock program. Preliminary results of a BPA funded study indicate that more than 50% of kelt held for reconditioning may survive and remature.

5. **RPA Action**

The following action relating to adult studies are quoted from the Endangered Species Act, Section 7, Biological Opinion on the Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin, dated December 21, 2000.

Action 109. "The Corps shall initiate an adult steelhead downstream migrant (kelt) assessment program to determine the magnitude of passage, the contribution to population diversity and growth, and potential actions to provide safe passage."

Action 199: "The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H."

90. Dworshak Dam Dissolved Gas Abatement Study

Multi-Year Plan

1. Project Information

- **Purpose/Objective**
  Spillway, low level regulating outlets and some turbine operations at Dworshak Dam produces increased levels of total dissolved gas (TDG) in the tailwater area of the project. The levels of increased TDG can effect aquatic life and migratory salmonids which may be present in the river below the dam. The purpose of this work effort would be to examine current project TDG performance and identify and implement operational or structural methods to decrease the production of TDG to acceptable levels.

- **Description**
  Total dissolved gas production at Dworshak dam may possibly contribute to elevated gas levels observed in the mainstem Clearwater River and at Lower Granite dam and can be problematic for a US Fish and Wildlife fish hatchery (Dworshak Hatchery) located immediately downstream from the dam on the North Fork Clearwater River.

2. Major Activities/Tasks

The following tasks or activities are anticipated to address the Dworshak dissolved gas issues.

a) conduct field investigations to define performance of individual project features ie. low level outlets; turbines, spillway. Additional field monitoring of mainstem Clearwater and Snake River above Lower Granite dam may be needed to assess Dworshak effects.
b) conduct hydrological analysis to define 7Q10 and probability of certain operations and discharges.
c) Identify and evaluate potential operational or structural changes which may alleviate or reduce production of TDG ie. Additional turbine installation, modifications to spillway etc.
d) If needed, construct sectional spillway hydraulic model replicating gates, low level outlets and stilling basin. Purpose of model would be to evaluate potential structural changes to alleviate production of TDG.
e) Prepare technical report documenting investigations, potential solutions and associated costs. Report will make recommendations concerning the next steps.
f) Optional Task - Prepare contract documents. If recommendations from the technical report include structural modifications, then contract documents would be prepared for construction.
g) Optional Task – Construct recommended modifications

Milestone(10pt)	**Date (Mo/Yr)** (10pt)
Hydrologic analysis	Oct ’02 – Nov ‘02
Field investigations	Dec ’02 - Feb ‘02
Construct & Test physical hydraulic model	Oct ’02 - Sep ‘02
Prepare technical report	Oct ‘03 – Sep ‘04
Prepare contract documents	TBD
Construction	TBD

3. **Cost Estimate** (10 pt) – Provide total cost estimate by Fiscal Year

FY02	FY03	FY04	FY05	FY06
$480,000	**$250,000**	**TBD**	**TBD**	**TBD**

4. **Issues**
   Costs are very rough estimates. Development of plans and specifications and construction costs are not presented here but will be identified in the technical report. Funding for this effort is Operation and Maintenance funding.

5. **RPA Action –** The following action relating to TDG abatement at Dworshak dam are quoted from the Endangered Species Act, Section 7, Biological Opinion on the Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin, dated December 21, 2000.

   Action 139 states: "The Corps shall investigate TDG abatement options at Dworshak Dam and implement options, as warranted, in coordination with the annual planning process."

96. Columbia Falls Reinforcement

1. Project Information

Transmission capacity from Hungry Horse Dam was has been limited during lightning storms which has limited drafting flexibility at this FCRPS storage dam. Transmission reinforcements are scheduled for completion in December, 2001 that will remove this constraint. The West of Hatwai Transmission Reinforcement has a different purpose than the Columbia Falls Reinforcement project in that it will increase the total east-west transfer capability through the Flathead Valley.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
EIS Scoping	
Draft EIS	
Final EIS	
Record of Decision	
Land Acquisition	
Construct/Test/Energize	December, 2001

3. RPA Action –

- 56, BPA's Transmission Business Line shall continue efforts to improve the transfer limitations from Montana.

97. Schultz-Hanford Area Transmission Line Project

1. Project Information

The proposed 59-mile-long 500-kV single-circuit transmission line would be constructed from the existing Schultz Substation near Ellensburg, Washington, to the existing Hanford or Ashe Substation on the Hanford Nuclear Reservation, or to a new substation west of the reservation. The new line is necessary to relieve constraints on several transmission paths (lines) the move electricity across Washington. The new line would also provide more operational flexibility and meet market needs by increasing transmission capacity for interstate transfer of electricity. BPA has identified several possible alternative routes for the new line. The new routes have the potential to cross private land, the Yakima Firing Center, the Hanford Nuclear Reservation, the Columbia River, and the Saddle Mountain Wildlife Refuge. BPA has filed a notice of intent to prepare an environmental impact statement, and in the process of contacting the U.S. Department of the Army, the U.S. Bureau of Land Management, the U.S. Bureau of BOR, and the U.S. Fish and Wildlife Service to determine whether they would like to be cooperating agencies in the EIS process

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
EIS Scoping	12/15/2000-1/25/2001
Draft EIS	November 2001
Final EIS	December 2002
Record of Decision	March 2003
Land Acquisition	2003-2004
Construct/Test/Energize	2004-2005

3. Cost Estimate -

Activity	FY02	FY03	FY04	FY05	FY06
				0	0

- **Issues –** Environmental and land acquisition issues are difficult to predict. If significant public opposition to the new line occurs, completion of the project could be delayed.

4. RPA Action –

- 55, To improve the future flexibility of the transmission system, BPA's Transmission Business Line shall initiate planning and design necessary to construct a Schultz-Hanford 500-kV line or an equivalent project, with a planned schedule for implementation by 2004 or 2005.

98. Report on New Generation caused Transmission Reinforcements

1. Project Information

BPA's Transmission Business Line is routinely requested to provide transmission integration and delivery services from new proposed generation projects. At times new transmission lines are required to accommodate these service requests.

Many new energy resources (nearly 20,000 MW) both natural gas fueled combustion turbines and wind generators have been proposed in the NW in the last year. BPA's transmission business line recently announced that a number of new transmission lines would need to be built to serve these new generators.

FCRPS spill operations called for in the BO at times must be reduced because all of the capacity on existing transmission lines has been contracted to PA customers. NMFS has requested in RPA 57 that BPA limit future transmission reservations to enable full implementation of the spill provisions in the BO, and to report progress in its annual IP report.

BPA's Power Business Line, due to FERC standards of conduct requirements, cannot be provided this type of information by the BPA Transmission Business Line. Thus, a report to NMFS will be provided by BPA's Transmission Business Line under separate cover from the annual IP report.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
EIS Scoping	
Draft EIS	
Final EIS	
Record of Decision	
Land Acquisition	
Construct/Test/Energize	

Issues – Environmental and land acquisition issues are difficult to predict. If there is significant public opposition to the lines from proposed new generators, the ability to relieve transmission constraints would be delayed beyond the 4-5 years that is normally required to build major new transmission lines.

3. RPA Action –

- 57, BPA's Transmission Business Line shall continue to evaluate strategically located generation additions and other transmission system improvements and report progress to NMFS annually. BPA's Transmission Business Line shall also limit future reservations for transmission capacity, as needed, to enable additional spill to meet performance standards, while minimizing effects on transmission rights holders.

99. Report on New Generation Related Transmission Reinforcements

1. Project Information

BPA's Transmission Business Line is routinely requested to provide transmission integration and delivery services from new proposed generation projects. At times new transmission lines are required to accommodate these service requests.

Many new energy resources (nearly 20,000 MW) both natural gas fueled combustion turbines and wind generators have been proposed in the NW in the last year. BPA's transmission business line recently announced that a number of new transmission lines would need to be built to serve these new generators.

FCRPS spill operations called for in the BO at times must be reduced, because all of the capacity on existing transmission lines has already been contracted to BPA customers. NMFS has requested in RPA 57 that BPA limit future transmission reservations to enable full implementation of the spill provisions in the BO, and to report progress in its annual IP report.

BPA's Power Business Line, due to FERC standards of conduct requirements, cannot be provided this type of information by the BPA Transmission Business Line. Thus, a report to NMFS will be provided by BPA's Transmission Business Line under separate cover from the annual IP report.

2. Major Activities/Tasks

Milestone	Date (Mo/Yr)
EIS Scoping	
Draft EIS	
Final EIS	
Record of Decision	
Land Acquisition	
Construct/Test/Energize	

Issues – Environmental and land acquisition issues are difficult to predict. If there is significant public opposition to the lines from proposed new generators, the ability to relieve transmission constraints would be delayed beyond the 4-5 years that is normally required to build major new transmission lines.

3. RPA Action –

- 57, BPA's Transmission Business Line shall continue to evaluate strategically located generation additions and other transmission system improvements and report progress to NMFS annually. BPA's Transmission Business Line shall also limit future reservations for transmission capacity, as needed, to enable additional spill to meet performance standards, while minimizing effects on transmission rights holders.

100. Water Quality Effects on Bull Trout Survival Near Hydro-projects

Multi-Year Plan

1. Project Information

- **Purpose/Objective -** Hydro management for anadromous salmon and steelhead has changed thermal regimes and TDG supersaturation production and distribution in the Snake River basin. An altered thermal regime in the main- stem Snake River and Clearwater River could change the movements and survival of bull trout. As a result bull trout could cue to move to more productive or refuge conditions later in the summer at a time when flows are low and water temperatures become lethal. Temperature drives many biological processes in fish. As a result, indirect temperature effects related to timing and duration of augmented cool water releases from Dworshak reservoir may cause substantial extra and delayed mortality to bull trout juveniles and subadults passing through the Clearwater River and lower Snake River dams and reservoirs. Adult bull trout may encounter high river temperatures or supersaturated dissolved gasses en route to entrance into tributaries. High temperatures may reduce reproductive success, increase susceptibility to disease, accelerate loss of energy reserves, extend passage delay and elevate stress of adult bull trout. Exposure to high concentrations of supersaturated dissolved gasses can be fatal to adult salmonids. Not enough scientific evidence is available to accept a generalized assumption that %TDGS exposure above 110% to bull trout would be similar enough to salmon. There are documented differences in response between salmon and steelhead (i.e., salmon and trout), therefore likely differences between salmon and char, especially considering differences in their body composition and habits of distribution. It is not known whether adult salmon migrants, therefore adult bull trout are able to avoid areas of high temperatures or supersaturated gasses or how these variables affect their reproductive success.

- **Description** – Evaluate the effect of critical water quality parameters on distribution of bull trout including temperature, turbidity, and total dissolved gas concentrations and distribution between Lower Monumental and Lower Granite dams.

2. Major Activities/Task –

a. Evaluate the effect of critical water quality parameters on distribution of bull trout including temperature, turbidity, and total dissolved gas concentrations and distribution between Lower Monumental and Lower Granite dams.
b. Identify physiological indicators of acute and chronic thermal stress on growth, development, and movement.
c. Identify performance-related changes of critical bull trout lifestages exposed to acclimated and unacclimated sub-lethal temperatures and %TDGS and correlate to exposure during river or reservoir passage.
d. Estimate the risk of mortality of current range of temperature and %TDGS regimes on bull trout life history during in-river movements of juveniles and adults during each season.
e. Determine frequency and duration of cool water microhabitat use by identifying differences between temperature exposure of tagged fish and river temperatures.
f. Determine whether cool water releases from Dworshak affect movement patterns of adult bull trout or whether movement routes are associated with cool water corridors.
g. Determine whether known source Snake River basin bull trout tagged with radio transmitters and depth recorders avoid gas supersaturated water by sounding.

Milestone	Date (Mo/Yr)
Evaluate Impact of SR Temperature and Dissolve Gas on Bull Trout	Jan / 2002

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$300k*				

* Pending on study design and ongoing work in this area.

4. Issues –

5. RPA Action –

- Action **1**, Bull trout under Action for Lower Snake Clearwater River: "The action agencies shall determine the presence of, and use by, bull trout in the mainstem Snake River, and shall implement monitoring and studies to provide critical information on bull trout distribution, timing, and usage of the Lower Snake River dams and reservoir system. This information shall be used, as appropriate, to modify facilities and/or operations."

101. Juvenile Salmon Transportation Evaluations

Multi-Year Plan

1. Project Information

- **Purpose/Objective** - Significant controversy surrounds the multi-year data sets of juvenile salmonid transport research. Although the majority of tests with spring chinook salmon, steelhead and fall chinook salmon show at least a measurable, if not significantly better return of transported to "control" fish, some entities question the validity of the data set due to concerns such as handling and marking effects on the treatment groups.

  To re-evaluate the question of transport benefit relative to immigrant survival, from Lower Granite, efforts have been made to redesign the experiment to answer critical questions relating to transport benefits (increasing the wild fish for the non-PIT tag detected group while reducing the numbers of wild fish to be marked. This study was designed to compare the benefits of transportation to maximized in-river passage using the best operation conditions that were designated for in-river passage conditions each year. Currently four years of releases have been completed (1995, 1996, 1998 and 1999 releases) from Lower Granite with chinook and (1999) steelhead under the original study design. The new study design was used in the releases for 2000 (wild spring summer chinook and steelhead), however fall chinook has not yet been incorporated into the study. Preliminary information from returns indicate that different barging strategies may offer additional increased survival, information from additional years of returns are needed to support future changes to the current operation.

  Evaluations on the benefits of transportation from McNary for spring/summer chinook, fall chinook, and steelhead will also be conducted to determine the absolute and comparative return rates of smolts transported to smolts that complete their outmigration within the river under various river, weather conditions.

- **Description** – This work focuses on determine the absolute and comparative adult return rates of smolts transported from Lower Granite and McNary to smolts that complete their outmigration within the river. The information from these evaluations will provide data the helps to narrow the range of variability of delayed mortality for transported fish. In management terms these study provide the foundations for refining the transportation program to provide the best strategies for transportation under a variety of seasonal and environmental conditions.

2. Major Activities/Tasks -

a. Determine absolute return rates and comparison ratios of outmigration survival and return rates for transported and in-river migrating spring summer and fall chinook and steelhead smolts. (stock specific)
   - Mark juvenile wild spring chinook and steelhead at Lower Granite (2000 – 2002) and fall chinook at hatcheries with PIT tags. (2001-2006)
   - Mark juvenile chinook (fall and spring/summer) and steelhead at McNary with PIT tags (multi-year evaluation). Again, when possible correlate to specific stocks. (2001-2004)

b. Evaluate fish condition (including stress levels, health, and smoltification) in each marking year throughout the season. (duration of study)
   - Document changes in nutritional status, including the concentration of macroelements that control osmoregulation during the barging process as they relate to delayed mortality. (Pilot study 2000)

c. Evaluate and correlate post-release survival and migration behavior of transported and inriver migrants through the estuary and Columbia River plume. Monitor with the PIT tag trawler, radio telemetry and sonic telemetry. (Steelhead and fall chinook 2000-2006)

d. Monitor returning adults. (through 2008). By manual count or through Adult PIT tag detection.

e. Evaluate the effects of handling and marking on survival (immediate and post-hydrosystem) and adult return rates. Explore the feasibility of pre marking wild fish in the tributaries.

Milestone	Date (Mo/Yr)
Lower Granite Transport Evaluation, spring chinook and steelhead - finish	March 2003
Lower Granite Transport Evaluation fall chinook (start FY01) - finish	March 2007
McNary Transport Evaluation – Design Evaluation – Report due	March 2002
McNary Transport Evaluation start FY01 - finish	March 2005
Adult Monitoring	December 2008

2. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$3320k	$3140k	$2620k	$2700k	$950k

3. Issues – Low flows and spill operation, availability of research fish and the timely installation of adult PIT tag detectors at Ice Harbor, McNary and Priest Rapids Dams may delay or compromise the study design. These evaluations of transport require not only the marking of juvenile salmon and the monitoring of returns as adults, but also, the physiological assessment of changes in fish condition prior to, during and following transport; details on migration behavior following release from the barges; downstream timing, survival data, ocean timing and avian predation monitoring in and downstream of the hydrosystem; and the addition of sample groups in the delayed mortality rearing study. The PIT trawler provides necessary timing, behavior, ocean entry information and also, survival data for the transport study.

4. RPA Action

- **Supports Elements Under Reasonable and Prudent Alternative:**
  Action 45: "By the end of 2001, the Corps shall develop, in coordination with NMFS and the other Federal, state, and Tribal salmon managers, a McNary Dam transportation evaluation study plan specifically focusing on the response of UCR spring chinook and steelhead to transportation. Approved research should begin by 2002, if feasible."

  Action 46: "The Corps and BPA, in coordination with NMFS through the annual planning process, shall evaluate transport to inriver return ratios for wild SR yearling chinook salmon and steelhead. In addition, the Corps and BPA shall also evaluate the effects of transportation on summer-migrating subyearling SR chinook salmon."

- **Supports Elements Under Reasonable and Prudent Alternative:**
  Action 189: "The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies and analyses to evaluate relationships between ocean entry timing and SARs for transported and downstream migrants."

Action 185: "The Action Agencies shall continue to fund and expand, as appropriate, fish marking and recapturing programs aimed at defining juvenile migrant survival for both transported and nontransported migrants and adult returns for both groups. These studies shall also compare the SARs of transported and nontransported fish to calculate the differential delayed mortality (D), if any, of transported fish."

Action 186: "The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for comparative evaluations of the **behavior and survival of transported** and downstream migrants to determine whether causes of D can be identified for the reach between Bonneville Dam and the mouth of the Columbia River."

Action 52: "The Corps shall identify and implement improvements to the transportation program."

Action 47: "During all transport evaluations, the Corps and BPA, in coordination with NMFS through the annual planning process, shall include an evaluation of delayed mortality (D) of transported versus inriver migrating juvenile anadromous salmonids."

Action 49: "The Corps shall evaluate strategies to enhance post-release survival of transported fish; examples of such strategies include timing releases so that fish arrival at the estuary corresponds to minimal interactions with predators and maximum availability of forage and locating releases so as to decrease passage time through areas of high predation."

Action 195: "The Action Agency shall investigate and partition the causes of mortality below Bonneville Dam after juvenile salmonid passage through the FCRPS." "…include…the extent of delayed mortality, which is uncertain and central to decisions about hydrosystem configuration and the role of juvenile salmonid transportation…."

Action 199: "The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H."

102. Bull Trout Distribution, Timing, and Usage of the Lower Snake River Reservoirs
RPA 1 Under Snake River RM&E, USFWS

Draft Multi-Year Plan
19 February 2001

1. Project Information

- **Purpose/Objective -** There is significant regional concern regarding the effects of lower Snake River hydro operations centric to salmon and steelhead upon bull trout populations in the Columbia Basin. Dams could cause delay as partial barriers to movements by bull trout that enter the mainstem lower Snake River from seasonally warmer tributaries. Little is known of bull trout occurrence, timing, or behavior in the immediate vicinity of hydroelectric dams or through reservoirs. Although window count monitoring has documented that bull trout move into adult fishways and likely past dams, criteria for optimal conditions for their preferred route of passage is unknown. Incidental information indicates that bull trout prefer lower critical velocities and vertical slots down to the floor where subadults prefer to habit, and avoid passage through orifices or over weirs designed for salmon, possibly related to water velocities and lack of preference to jump.

- **Description** – Little is known regarding the number of mainstem moving bull trout, their distribution criteria, or their survival through the FCRPS. By tagging bull trout and monitoring their movements downriver and upriver through the FCRPS and critical tributaries where occupied, a better understanding of routes of passage and survival of bull trout. This information is needed in order to develop effective protection measures for these fish, such as establishing construction windows.

2. Major Activities/Tasks –

a. Investigate the distribution and enumerate the abundance of bull trout in their critical tributaries, then movement into the forebay and tailrace of the lower Snake River dams.
   - Periods of occurrence and correlative reasons for timing of movements and distributions.
   - Size when distributed in reservoirs.
   - Depth of water inhabited.
   - Determine diurnal and seasonal variability in abundance and distribution.
   - Determine the proportion of tagged bull trout that return to critical tributaries to spawn.

b. Evaluate routes of passage through the hydro-projects.
   - Evaluate effectiveness or impediments of bull trout passage through the lower Snake River dams without affecting salmon and steelhead passage.
   - Investigate improvements (structural or operational) to enhance bull trout passage.
   - Determine the number and seasonal timing of adult bull trout that fallback through the facility. Then, evaluate the effect of specific project operations at lower Snake River dams on the fallback routes, percentages and rates between low spill with high SE and spill to 120% TDG at lower Snake River Dams.

c. Evaluate adult bull trout counting and sampling capability and validate accuracy at lower Snake River dams and upriver tributary index sites.

Milestone	**Date (Mo/Yr)**
Radio Telemetry of Bull Trout in the Snake River and mouths of tributaries	Jan / 2002
Evaluation of impact of design criteria on bull trout injury and survival	Jan / 2002

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$500k*				

* Place holder funds.

4. Issues –

5. RPA Action

- **Directly Supports Reasonable and Prudent Alternative:**
  Action 1, Bull trout under Action for Lower Snake Clearwater River: "The action agencies shall determine the presence of, and use by, bull trout in the mainstem Snake River, and shall implement monitoring and studies to provide critical information on bull trout distribution, timing, and usage of the Lower Snake River dams and reservoir system. This information shall be used, as appropriate, to modify facilities and/or operations."

103. Dworshak Reservoir Bull Trout Distribution to North Fork of the Clearwater River
RPA 2 Under Dworshak RM&E, USFWS

Draft Multi-Year Plan
19 February 2001

1. Project Information

- **Purpose/Objective** - In August of 1994 and 1998 when pool elevations were dropped to a low for augmenting lower Snake River flow for salmon, water column temperature and dissolved oxygen concentrations and distribution reached lethal limits for bull trout in the upper reaches of Dworshak reservoir near the North Fork of the Clearwater River.

- **Description** – Radio telemetry will be used to characterize the basic biology, seasonal distribution, abundance, spawning timing and sites, and migration range of bull trout in the Dworshak reservoir and associated tributaries. This work also includes the evaluation of current Dworshak Dam operations on the bull trout entrainment and population characteristics.

2. Major Activities/Tasks -

a. Determine bull trout temporal and spatial distributions within Dworshak Reservoir Project Area by use of non- intrusive methods, survey all Dworshak reservoir tributaries (except North Fork Clearwater and Little North Fork Clearwater rivers).

b. Determine timing and extent of migration into the North Fork and Little North Fork Clearwater Rivers and tributaries including the establishment of monitoring areas for annual redd counts to establish trends in spawning success and production.

c. Describe relative abundance of kokanee fry to bull trout distribution and seasonal utilization in bull trout diet.

d. Determine degree of partial blockage of bull trout to spawning/rearing habitat through physical hydraulic changes or water temperature and dissolved oxygen distributional changes during the peak and duration of the water elevation drawdown of Dworshak reservoir for lower Snake River flow augmentation for salmon (ramping rate of 11+ kcfs down to water surface elevation 1500' during late-June through August).

Milestone	Date (Mo/Yr)
Radio Telemetry of Bull Trout in Dworshak – start FY 01 - Complete	Mar / 2004

3. Cost Estimate

FY02	FY03	FY04	FY05	FY06
$175k	$180k	$75k		

4. Issues –

5. RPA Action

- Action 2, Bull trout under Action for Lower Snake Clearwater River: "The action agencies shall implement monitoring and studies to provide critical information on bull trout entrainment and distribution, timing, and usage of Dworshak Reservoir for modifying facilities and/or operations."

References:

Fish Passage Plan – December 2000