Appendix J

Typical Environmental Consequences of Potential Implementation Actions

Appendix J

TYPICAL ENVIRONMENTAL CONSEQUENCES OF POTENTIAL IMPLEMENTATION ACTIONS

The following two tables provide estimates of many of the environmental consequences of potential fish and wildlife mitigation and recovery actions and program activities. The actions and activities could be implemented to benefit fish and wildlife under one or more of the alternative Policy Directions considered in this document. It should be noted that these are sample implementation actions and effects only; that is, the list is not intended to be all-inclusive.

Most of the information has been developed through attempts in other EISs and fish and wildlife documents to quantify the environmental consequences using appropriate units and measures. In many cases, ranges of values provide the best available estimates for activities with varying outputs and costs. The estimates should be used for comparative purposes only; actual consequences of individual projects may vary and are expected to change over time.

The actions and activities are aligned with the major categories of environmental consequences considered in Chapter 5 of this EIS to make it easier to cross-reference.

- Table A provides estimates of many social and economic consequences that could result from implementation of potential fish and wildlife actions.
- Table B gives the typical impacts from alternative methods of energy generation that could affect air, land, and water.

The estimated environmental consequences of sample actions and activities are useful for those who may wish to build their own Policy Direction alternative. The intent of this Appendix is to provide the reader with information to better understand the tradeoffs among program elements.

NOTE: All dollar values are economic costs. Most of the values are based on information in the Northwest Power Planning Council's *Human Effects Analysis of the Multi-Species Framework Alternatives.*[1] That analysis was itself based on secondary information from recent environmental, economic, and policy analyses in the Region. A range is provided where estimates were provided for more than one location, or where multiple references were available. Many of the estimates were derived from research conducted for the Lower Snake River Juvenile Migration Feasibility Study.

Cost information in the tables pertains to the costs of fish and wildlife recovery and mitigation actions. Most hydrosystem costs are expressed as the cost per dam affected. Costs are expressed in terms of their one-time cost and the annualized equivalent. The annual equivalent was calculated assuming 4.75 percent real interest. Payment periods vary

[1] Council, 2000a.

depending on the type of action, but are generally 50 years or longer. Most hydrosystem data are from the Lower Snake River Juvenile Migration Feasibility Study, the John Day feasibility study, and from Federal planning documents.

Most habitat cost data are based on costs of agricultural and forestry practices provided by the USDA. Some habitat cost estimates are based on costs of projects funded by BPA. Cost data are generally expressed as cost per acre, though cost per mile is generally more appropriate for stream restoration practices. Cost per project is used where no better physical measure is possible.

Hatchery cost data are available from Federal sources, and statistical summaries of these data yield cost per pound of fish produced. The range of costs may reflect the age and size of fish produced, different species, and different operators. Costs of actions to reduce harvest are generally based on lost net revenues in the fishing industry, but costs of targeted fisheries can be based on the costs of implementing the new practices.

The air, land, and water data came mainly from the BPA Business Plan FEIS and Resource Programs FEIS. Several energy resources data such as diesels, simple cycle combustion turbines, and fuel cells have been added to the range of effects information provided in the BPEIS. The information from this EIS, Business Plan FEIS, and Resource Programs FEIS should give the reader a broad perspective on the air, land, and water emissions of energy resource development and operation.

Table A: Typical Fish and Wildlife Social and Economic Consequences of Implementation Actions

Action/Activity	**Environmental Effect** (One-time Cost per Unit)	**Annualized Environmental Effect** (Cost per Unit per Year)	Unit of Measure	Reference
Agriculture, Crop Switching on Irrigated Land		50-100	$ cost/acre irrigated	
Agriculture, Crop Management (modified cultivation practices, conservation tillage, no-till agriculture, development of small ponds to retain water)	Not quantified, Potentially major		$ cost/acre managed	
Agriculture, Erosion Management on Dry Land		10-30	$ cost/acre managed	USDA 1996a, 1997
Agriculture, Fallow Irrigated Land		100-300	$ cost/acre fallow	
Agriculture, Irrigation Water Management		10-100	$ cost/acre irrigated	USDA 1996a, 1997
Agriculture, Nutrient/Pesticide Management: Irrigated Land		5-40	$ cost/acre managed	USDA 1996a, 1997
Agriculture, Nutrient/Pesticide Management: Dry Land		5-10	$ cost/acre managed	USDA 1996a, 1997
Agriculture, Retire Irrigated Land	2,000-5,000	95-240	$ cost/acre retired	

Table A: Typical Fish and Wildlife Social and Economic Consequences of Implementation Actions

Action/Activity	**Environmental Effect** (One-time Cost per Unit)	**Annualized Environmental Effect** (Cost per Unit per Year)	Unit of Measure	Reference
Agriculture, Retire Dry Land/Convert to Native Vegetation	500-1,000	25-50	$ cost/acre retired	
Agriculture, Screen Irrigation Diversions		5-47	$ cost/cfs diversion capacity screened	USDA 1996b
Dam Breach Mainstem: Hydropower Loss		55-66 (Lower Snake Dams) 215-250 (John Day)	Million $ cost/ dam breached	Corps 1999a, 1999d
Dam Breach Mainstem: Implementation	202 (Lower Snake Dams); 2,500 (John Day)	10 (Lower Snake Dams); 120 (John Day)	Million $ cost/ dam breached	Corps 1999d, 1999e
Dam Breach Mainstem: Increased Transmission Cost	120-144 (Lower Snake Dams)	5-6 (Lower Snake Dams)	Million $ cost/ dam breached	Corps 1999d
Dam Breach Mainstem: Facilities Cost Savings		Some dam modification costs would be avoided by breaching if the costs would be required for the dams that are breached	Million $ cost saved by breaching	
Dam Breach Mainstem: Navigation Loss		25 (4 Lower Snake Dams); 95 (John Day)	Million $ loss/ group of dams) breached	Corps 1999d, 1999e
Dam Breach Mainstem: Operations and Maintenance Cost Savings		34(4 Lower Snake Dams); 10 (John Day); 10 (McNary)	Million $ cost saved by breaching	Anderson 1999
Dam Breach Mainstem: Other Recreation Loss		8 (Lower Snake Dams)	million $ cost/ dam breached	Corps 1999d, 1999f
Dam Breach Mainstem: Recreational Fishing Loss		0.4 (Lower Snake Dams)	million $ cost/ dam breached	Corps 1999d, 1999f
Dam Breach Mainstem: Water Supply (Irrigation) Reduction	50-61 (Lower Snake Dams); 370 (John Day); 400 (McNary)	2 (Lower Snake Dams); 20 (John Day 20 (McNary)	million $ cost/ dam breached	Corps 1999d, 1999e
Dam Breach Tributary: Implementation Costs	10-20	0.5-1.0	million $ cost/ dam	CBB 1999a

Table A: Typical Fish and Wildlife Social and Economic Consequences of Implementation Actions

Action/Activity	**Environmental Effect** (One-time Cost per Unit)	**Annualized Environmental Effect** (Cost per Unit per Year)	Unit of Measure	Reference
Dam Modification: Change Dam Operations (Spills and Flows)		Depends on specifications; Changes in power, recreation, flood control, and water supply may be important		
Dam Modification: Dissolved Gas and Temperature Control	5-32	0.3-2.1	million $ cost/ dam modified	Anderson 1999
Dam Modification: Other Juvenile Transport and Bypass System Improvements	5-116	0.3-5.8	Million $ cost/ dam modified	Anderson 1999
Dam Modification: Surface Bypass Systems	50-250	2.6-13	Million $ cost/ dam modified	Anderson 1999
Dam Modification: Turbine Improvements	2-10	0.1	Million $ cost/ turbine rehabilitated (Each dam has 6-22 turbines)	Kranda 1999
Education, Public Environmental	1,000-100,000		$ cost/ educational event	
Enforcement, Fish and Wildlife Regulations	25,000-60,000		$ cost/ employee/year	
Forestry, Controlled Burn	25-56	3-6	$ cost/acre treated	ICBEMP 2000a; USDA 1996c
Forestry, Eliminate Timber Harvest	125-1,500	6-71	$ cost/acre not harvested	Quigley 1997; USDA 1996c
Forestry, Limit Size of Clearcuts	<125-1,500	<6-71	$ cost/acre of deferred harvested	Quigley 1997; USDA 1996c
Forestry, Reforestation	300-500	15-24	$ cost/acre reforested	USDA 1996c
Forestry, Shelterwood/ Group Selection Harvest	50-100 + net on deferred timber harvest	56-130	$ cost/acre treated	Quigley 1997
Forestry, Thinning	81		$ cost/acre thinned	ICBEMP 2000a
Habitat Improvement, Active Meander Restoration	10,000–100,000	475– 4,750	$ cost/acre restored	BPA 1999
Habitat Improvement, Channel Modification (Substrate, configuration, reconnect side channels, etc.)	9,000–100,000 or more	475– 4,750 or more	$ cost/mile of stream modified	BPA 1999; ICBEMP 2000a

Table A: Typical Fish and Wildlife Social and Economic Consequences of Implementation Actions

Action/Activity	**Environmental Effect** (One-time Cost per Unit)	**Annualized Environmental Effect** (Cost per Unit per Year)	Unit of Measure	Reference
Habitat Improvement, Construct/Restore Wetlands	2,000-10,000	100– 470	$ cost/acre constructed	USDA 1996b
Habitat Improvement, Dike Removal in Estuary	Not quantified, potentially significant		$ cost/mile of dike removed	
Habitat Improvement, Floodplain Structure Buyback			$ cost/property purchased	
Habitat Improvement, Instream Structures	30,000	1,425	$ cost/mile of stream modified	BPA 1999
Habitat Improvement, Monitoring (Improve environmental data management systems)		25,000-60,000	$ cost/person/ year	
Habitat Improvement, Reconnect Aquatic Habitats	9,000–100,000 or more	475– 4,750 or more	$ cost/project	BPA 1999; ICBEMP 2000a
Habitat Improvement, Remove Passage Obstruction (Culverts, low-head dams, weirs)	5,000-50,000	240–2,400	$ cost/ obstruction removed	BPA 1999
Habitat Improvement, Research	10,000-300,000		$ cost/research project	
Habitat Improvement, Riparian	300		$ cost/acre of riparian area improved	ICBEMP 2000a
Habitat Improvement, Road Management (Upgrades, maintenance, closing, and removing roads)	5,800		$ cost/mile of road treated	ICBEMP 2000a
Habitat Improvement, Utility and Transportation Corridors (Adjust vegetation management and maintenance)	Not quantified, potentially significant		$ cost/mile of corridor adjusted	
Habitat Improvement, Water Rights Purchase (1 Million Acre-Feet of Water from Upper Snake River)		75–85	Million $ total cost	USDOI/ Bureau 1999
Habitat Improvement, Wildlife Habitat (Seral stages, snags, downed wood, large trees, and preferred species)	44	2.3	$ cost/acre treated	ICBEMP 2000a
Hatcheries, Construct New Facilities	20-40	1-2	Million $ cost/hatchery	Radtke & Davis 1997
Hatcheries, Demolition/ Decommissioning	50,000-200,000	2.6-10.5	Thousand $ cost/hatchery	

Table A: Typical Fish and Wildlife Social and Economic Consequences of Implementation Actions

Action/Activity	**Environmental Effect** (One-time Cost per Unit)	**Annualized Environmental Effect** (Cost per Unit per Year)	Unit of Measure	Reference
Hatcheries, Increase Fish Production in Existing Facilities		2-6	$ cost/pound of smolts	Radtke & Davis 1997
Hatcheries, Increase Fish Production in New Facilities (including O&M)		7-10	$ cost/pound of smolts	Radtke & Davis 1997
Power, Build Replacement Generation Facilities	Varies, may be significant	Varies, may be significant	$/aMW	
Power, New Transmission Line Right-of-Way	2.7-4.4		ha dedicated to ROW/km of transmission line	USDOE/BPA 1993
Rangeland, Exclude Grazing from Riparian Zone		10-20	$ cost/acre excluded	USDA 1996a
Rangeland, Improvements/ Restoration	50		$ cost/acre treated	ICBEMP 2000a
Rangeland, Manage/ Eliminate Grazing (Seasonal or rotational grazing, reduced grazing intensity, deferred grazing)		1-5	$ cost/acre excluded	USDA 1996b
Rangeland, Noxious Weed Treatments	30	2.4	$ cost/acre treated	ICBEMP 2000a
Rangeland, Retire Rangeland	100-500	5-47	$ cost/acre retired	USDA 1996a, 1996b, 1997
Recreation, Controlled Recreation Intensity or Rotational Use	Varies, may be significant			
Recreation, Relocate Facilities Away from Sensitive Habitats	125-1,500	6-71	$ cost/acre not used	
Recreation, River (Floating, viewing, hiking)	71-297		$/river trip	Corps 1999d
Urban and Rural Development, Acquisition of Conservation Easements	1-100	.05-47	Thousand $/acre of easement acquired	
Urban and Rural Development, Improve Stormwater Treatment	1,000 - 3,000	50 – 150	$ cost/acre-foot of water treated	
Urban and Rural Development, Improve Wastewater Treatment	0.01-10	0.0005-.5	Million $/project	

Table B: Typical Impacts to Air, Land, and Water from Alternative Methods of Energy Generation

Types of Energy Conservation and Generation	Air Emissions						Water Consumed (yd^3/aMW)	Land Area Consumed (ac./aMW)
	SO_2	NO_X	CO_2	Particulates	CO	PAHs		
	(tons/aMW)							
Energy Conservation[a]	0.0	0.0	0	0.0	0.0		0	0.0
Power Efficiency Improvements[a]	0.0	0.0	0	0.0	0.0		0	0.0
Renewable Energy[a]								
Geothermal	0.8 H_2S	0.0	636	0.0	0.0		72,277	0.3
Solar	0.0	0.0	0	0.0	0.0		629	6.0
Wind	0.0	0.0	0	0.0	0.0		0	23.6
Hydro	0.0	0.0	0	0.0	0.0		0	0.0
Cogeneration[a]								
Solid Waste-Fired	13.6	70.2	13,256	3.0	2.7	+	0	2.0
Wood-Fired	0.5	9.0	11,959	1.7	17.0	+	87,604	2.6
Existing Natural Gas-Fired	0.0	5.3	3,542	0.0	2.0	+	5,486	0.2
Natural Gas Combustion Turbine[ab]								
Older	0.0-43.9	4.6-15.0	3,542-5,142	0.0-0.3	0.7-3.8	+	5,486	0.2
Newer	0.0-0.3	0.4-4.9	3,313	0.2	0.1-5.9	+	5,486	0.2
Natural Gas Reciprocating Engines (with NOx control) [b]	0.0	1.3-2.5	--	1.1-1.2	3.7-3.8	+	--	--
Large Stationary Diesel Engines[c] (greater than 600 horsepower [hp])	1.9-47.2		7,713	1.4-4.7	2.5-39.7	+	--	--
Without NO_X Control		149.6						
With NO_X Control		14.3-88.8						
Stationary Dual Fuel (5% diesel, 95% natural gas uncontrolled for NOx) Engines[c]	0.2	105.5	--	--	44.2	+	--	--
Nuclear Energy[a]	0.0	0.0	0	0.0	0.0		25,814	2.2
Coal[a]								
Common	8.6	21.6	8,843	1.3	1.5	+	17,247	1.3
Clean Fluidized-Bed Coal	3.1	5.3	8,052	0.6	1.4	+	26,507	1.6
Clean Gasification Coal	1.5	3.9	7,551	0.2	0.1	+	26,232	0.7
Fuel Switching (Gas water heaters and furnaces) [a]	0.0	2.4	2,550	0.0	1.1	+	0	0.0

Table B: Typical Impacts to Air, Land, and Water from Alternative Methods of Energy Generation

Types of Energy Conservation and Generation	Air Emissions						Water Consumed (yd^3/aMW)	Land Area Consumed (ac./aMW)
	SO_2	NO_X	CO_2	Particulates	CO	PAHs		
	(tons/aMW)							
Power Purchases (Assumed all combustion turbines) [a]	0.0	5.3	3,542	0.0	2.0	+	5,486	0.2
Fuel Cell [d]								
Solid Oxide	0.0	0.0	4,161	--	--	0.0	--	--
Phosphoric Acid Fuel Cell	0.1	0.0	4,722	--	--	0.1	--	--
Gas-Fired (Internal combustion) [d]								
Lean Burn Engine	9.6	0.0	4,853	0.1	21.9	9.6	--	--
Rich Burn Engine	2.2	0.0	6,027	0.1	17.5	2.2	--	--
Diesel Engine [d]								
Uncontrolled	95.5	2.0	6,272	3.4	27.2	95.5	--	--
Controlled	20.6	2.0	6,272	3.4	27.2	20.6	--	--
Gas Turbine [d]								
Micro Turbine (25kW)	1.9	0.0	6,990	0.4	5.3	1.9	--	--
Small (4,600kW)	5.0	0.0	6,544	0.4	3.1	5.0	--	--
Medium (12,900kW)	2.7	0.0	5,812	0.3	2.6	2.7	--	--
Simple Cycle Gas Engine [d]	1.4	0.0	5,055	0.3	2.2	1.4	--	--

[a] USDOE/BPA 1993 and USDOE/BPA 1995a.
[b] EPA 2000.
[c] EPA 1996.
[d] The Regulatory Assistance Project 2001.
+ = Present in emissions from incomplete combustion.
-- = No data.