APPENDIX to Enclosure 1

Supporting

BPA'S April 4, 2008 RECOMMENDATIONS FOR PROPOSED PROGRAM AMENDMENTS

June 10, 2008

TABLE OF CONTENTS

Page

APPENDIX TO BPA'S APRIL 4, 2008 RECOMMENDATIONS FOR PROPOSED PROGRAM AMENDMENTS 1

Appendix 3

Section A: Population Viability Analysis Estimating Survival Improvements Needed to Achieve Current Program Goals 3

Section B: FCRPS Action Agency Proposed Metrics and Performance Standards 5

Adult Salmon Reporting Metrics 6

Juvenile Dam Passage Survival Standards 7

Predation Management Performance 7

Hatchery Performance Standards 8

Performance Targets and Standards Summary 9

Section C: Summary of the ISAB's Climate Change Findings 11

Section D: Standard Definitions of the Types of RM&E Projects 14

Section E: Kinds of Coordination 15

Section F: Annualizing Wildlife Habitat Losses 17

Section G: Wildlife Habitat Cover Type/Species Matrix Explanation 18

Section H: Implementation Strategies for the Willamette Subbasin 19

Appendix

Section A: Population Viability Analysis Estimating Survival Improvements Needed to Achieve Current Program Goals

Dr. Richard Hinrichsen, a research scientist and BPA consultant, performed the calculations for this assessment. In the table below, the numbers in the second column represent the survival improvements needed (for individual chinook salmon populations) in order to achieve the Program goal. The Program goal is interpreted to mean that salmon populations should have less than a 20 percent risk of extinction over a 200 year time frame, while sustaining average harvest rates of 30 percent. The table shows multipliers relative to current values of lifecycle survival needed to meet the extinction criteria. For example, a value of 1.97 for the Tucannon population indicates a 97% improvement in lifecycle survival is needed to achieve the Program goal. A value of 8.49 for Marsh Creek indicates the need for a 749% survival improvement.

For the sake of comparison, the numbers in the column to the far right are included to show the Interior Columbia River Technical Recovery Team's viability "gaps," or the survival improvements that would be needed for a population to meet the minimal requirements for viability and recovery. The gaps are also shown as multipliers.

As one can see, in most cases the Program goal requires survival improvements greater than those needed for viability (full recovery) – in many cases far greater. This is not likely to be achievable within the next decade, as reflected in the Program's current goals.

This analysis uses the Interior Columbia Basin Technical Recovery Team Quasi-Extinction Threshold (QET) assumption that extinction occurs when a population falls below 50 spawners for four consecutive years. The assessment methods were consistent with the NOAA Fisheries assessments used for the 2008 FCRPS BiOp and similar to the TRT evaluations for Recovery Planning. The mathematical methods employed are documented in the Final FCRPS Biological Opinion's Aggregate Analysis Appendix in a paper (Hinrichsen 2008) titled Analytical Methods for Population Viability Analysis of Endangered ESUs of the Interior Columbia River Basin.

Chinook Salmon Population	Needed Survival Increase to Achieve Program Goal	ICTRT Viability Gap at 5% Risk
Tucannon Spring Chinook	1.97	2.23
Lostine River Chinook	3.08	2.04
Grande Ronde Upper Mainstem Chinook	4.52	4.09
Catherine Creek Chinook	7.25	2.00
Imnaha River Chinook	2.23	2.23
Minam River Chinook	1.86	1.73
Wenaha River Chinook	3.17	2.38
Secesh River Chinook	1.49	1.45
South Fork Salmon East Fork (inc Johnson Cr.)	1.67	2.33
Big Creek Chinook	5.28	2.34
Bear Valley Creek	2.33	1.65
Marsh Creek Chinook	8.49	2.19
Sulphur Creek	8.22	2.42
Valley Creek Chinook	10.21	2.07
Lower Mainstem Salmon River (SRLMA)	4.00	2.36
Upper Mainstem Salmon River (SRUMA)	1.30	1.44
Wenatchee River Chinook	1.78	1.73
Entiat River Chinook	2.58	1.76

Section B: FCRPS Action Agency Proposed Metrics and Performance Standards

Table 1[1]

Proposed RPA Strategy Overview

Hydro Action Objective for All ESUs: Improve the Survival of Juvenile and Adult Fish as They Pass Through the Hydrosystem	**Hydro Strategy 1**	Operate the FCRPS to More Closely Approximate the Shape of the Natural Hydrograph and to Enhance Flows and Water Quality to Improve Juvenile and Adult Fish Survival
	Hydro Strategy 2	Modify Columbia and Snake River Dams to Maximize Juvenile and Adult Fish Survival
	Hydro Strategy 3	Implement Spill and Juvenenile Transportation Improvements at Columbia River and Snake River Dams
	Hydro Strategy 4	Operate and Maintain Facilities at Corps Mainstem Projects to Maintain Biological Performance
Habitat Action Objective for All ESUs: Protect and Improve Tributary and Estuary Habitat to Improve Fish Survival	**Habitat Strategy 1**	Protect and Improve Tributary Habitat Based On Biological Needs and Prioritized Actions
	Habitat Strategy 2	Improve Juvenile and Adult Fish Survival in Estuary Habitat
Hatchery Action Objective for All ESUs: Fund FCRPS Mitigation Hatchery Programs in a Way that Contributes to Reversing the Decline of Downward-Trending ESUs	**Hatchery Strategy 1**	Ensure that Hatchery Programs Funded by the Action Agencies as Mitigation for the FCRPS are not Impeding Recovery
	Hatchery Strategy 2	Preserve and Rebuild Genetic Resources Through Safety-Net and Conservation Objectives to Reduce Extinction Risk and Promote Recovery
Harvest Action Objective for All ESUs: Improve Survival of Juvenile and Adult Fish as They Pass Through the Hydrosystem	**Harvest Strategy 1**	Fishery Conservation Effectiveness Programs
	Harvest Strategy 2	Potential Alternative/Terminal Fishing Locations
	Harvest Strategy 3	Develop Fishing Techniques to Enable Fisheries to Target Non-Listed Fish while Reducing Harvest-Related Mortality of ESA-Listed Species
Predation Management Action Objective for All ESUs: Improve Survival of Juvenile and Adult Fish as They Pass Through the Hydrosystem	**Predation Strategy 1**	Implement Piscivorous Predation Control Measures to Increase Survival of Juvenile Salmonids
	Predation Strategy 2	Implement Avian Predation Control Measures to Increase Survival of Juvenile Salmonids
	Predation Strategy 3	Implement Marine Mammal Control Measures to Increase Survival of Adult Salmonids at Bonneville Dam
RM&E Action Objective for All ESUs: Provide Information Needed to Support Planning and Adaptive Management and Demonstrate Accountability Related to Implementation of FCRPS ESA Hydropower and Offsite Actions for All ESUs	**RM&E Strategy 1**	Monitor Status of Selected Fish Populations Related to FCRPS Actions
	RM&E Strategy 2	Hydrosystem RM&E
	RM&E Strategy 3	Tributary Habitat RM&E
	RM&E Strategy 4	Estuary Habitat RM&E
	RM&E Strategy 5	Harvest RM&E
	RM&E Strategy 6	Hatchery RM&E
	RM&E Strategy 7	Predatation Management RM&E
	RM&E Strategy 8	Coordination and Data Management
	RM&E Strategy 9	Implementation and Compliance Monitoring

[1] FCRPS Action Agencies, Biological Assessment for Effects of FCRPS and Mainstem Effects of the Tributary Actions on Anadromous Salmonid Species Listed Under the ESA at page 2-2 (Aug. 2007).

Adult Salmon Reporting Metrics[2]

Adult abundance and trends reflect the most accessible currency with which to evaluate the progress in region-wide recovery efforts over multiple years. They give an indication of how both the naturally spawning and hatchery-based portions of a listed species are doing.

Adult trends are also indicators of variability in ocean survival conditions, which can significantly affect the numbers of adult anadromous fish over multiple years. Because adult trends are so critical to understanding the progress of listed fish toward recovery, the Action Agencies will regularly track and report available data on overall adult abundance and trends for the ESUs. Adult abundance and trends represent an overarching performance target, not just for the FCRPS, but also for the collective actions by all parties in the Columbia River Basin for the conservation and recovery of listed fish. Specifically, this overarching performance target is a positive trend in adult abundance.

The primary benchmark for assessing progress of FCRPS actions for conservation of ESA-listed fish is adult and juvenile survival through the hydrosystem. The Action Agencies have the greatest influence on this outcome, and it is less confounded by actions of others. Hydrosystem performance will be tracked and evaluated through adult reach survival and juvenile dam survival performance standards, and through a juvenile system survival performance target.

For adult fish, the Action Agencies have largely achieved or exceeded the performance standards identified in the 2000 BiOp (Ruff 2004). The Action Agencies will use the following adult dam survival performance standards to continue to meet or exceed expected adult survival standards.

Table 2 Adult Performance Standards

ESU	Adult Standard	Reach	Rationale
Snake River Spring Chinook Salmon	90%	Bonn. to Lower Granite	Longest migratory route
Snake River Summer Chinook Salmon	94%	Bonn. to Lower Granite	Longest migratory route
Upper Columbia Spring Chinook Salmon	92%	Bonn. to McNary	Longest migratory route

[2] *Id.* at page 2-5.

Snake River Fall Chinook Salmon	92%	Bonn. to Lower Granite	Longest migratory route
Willamette River Chinook Salmon	None	None	Low Encounter Rate
Lower Columbia River Chinook Salmon	None	None	Surrogate of upriver ESU
Snake River Steelhead	N/A	Bonn. to Lower Granite	Unaccounted harvest leads to uncertainty in calculations
Upper Columbia River Steelhead	N/A	Bonn. to McNary	Unaccounted harvest leads to uncertainty in calculations
Mid-Columbia River Steelhead	N/A	Variable	Unaccounted harvest leads to uncertainty in calculations
Lower Columbia River Steelhead	None	None	Upriver Steelhead ESU surrogate
Willamette River Steelhead	None	None	Low Encounter Rate
Snake River Sockeye Salmon	None	None	Uncertainty in data
Lower Columbia River Coho Salmon	None	None	Upriver Chinook ESU surrogate
Columbia River Chum Salmon	None	None	Low Encounter Rate

Juvenile Dam Passage Survival Standards[3]

The Action Agencies propose specific performance standards of 96 percent average relative dam survival for spring migrating fish and 93 percent average relative dam survival for summer migrating fish. Survival averaging or tradeoffs between dams may occur only among the Snake River dams or among the lower Columbia River dams, but not between Snake and Columbia River dams.

Predation Management Performance[4]

Management of piscivorous and avian predation of juvenile salmonids is an effective means of increasing juvenile fish survival (Beamesderfer et al. 1996, Roby et al. 1998, NMFS 2000, Good et al. 2004). The Action Agencies will pursue focused measures that reduce predation mortality in the near and long term. These measures will be monitored annually for Programmatic-level standards.

For both piscivorous and avian predation, estimates of juvenile fish survival improvements associated with the 2007 to 2017 Actions (3.1 percent for chinook salmon, 4.4 percent for steelhead, and 1.7 percent for fall chinook salmon) will serve as long-term performance targets.

[3] *Id.* at page 2-6.
[4] *Id.*.

Hatchery Performance Standards[5]

The Action Agencies have developed Hatchery actions that are expected to reduce extinction risk and increase abundance and productivity of several ESUs. The Hatchery Actions identify targeted populations and factors to be improved. Programmatic performance standards will be used, based on Action Agency commitments and implementation plans, to track implementation.

Although ongoing hatchery research, monitoring and evaluation (RM&E) has targeted many of the research needs described in the Hatchery Action, existing information remains insufficient to quantitatively estimate the effects of many of the actions proposed in the Hatchery Action, a view confirmed by the Hatchery/Harvest Workgroup. The expected benefits of the Action were qualitatively assigned as high, medium, or low value. These benefits represent the performance targets for adaptive management. Hatchery Action effectiveness research will help confirm and update the qualitative expectations of these benefits as new information becomes available.

These benefits (performance targets) are relative to the following objectives of the Hatchery Actions:

- Safety-net programs reduce extinction risk for target populations in Snake River sockeye salmon, Snake River spring/summer chinook salmon, Mid-Columbia River steelhead, lower Columbia River steelhead, and Columbia River chum salmon ESUs.
- Conservation hatchery programs increase abundance of target populations in Snake River spring/summer chinook salmon, Snake River fall chinook salmon, and upper Columbia River steelhead ESUs, thereby reducing the time to recovery.
- High-priority hatchery reform actions (i.e., those needed to address hatchery programs that are considered major limiting factors by NOAA Fisheries), result in improved abundance, productivity, diversity, and/or spatial structure of target populations.
- Future implementation of additional hatchery reforms identified through Columbia River Hatchery Scientific Review Group's hatchery review

[5] *Id.* at pages 2-8 through 2-9.

process, combined with use of best management practices (BMPs) at FCRPS hatchery facilities, improve abundance, productivity, diversity, and/or spatial structure of target populations, depending on the nature of the reform.

Hatchery effectiveness monitoring and research will be used in the 2012 and 2015 comprehensive evaluations to test and update the expectations of these benefits and gauge the progress. As best management practices are adopted for specific hatchery programs, they will provide additional performance measures that Action Agencies will track and report.

Performance Targets and Standards Summary[6]

Table 3 provides a summary of performance targets, standards, monitoring, and reporting under the performance-based framework that the Action Agencies developed. To aid the agencies' integration of their responsibilities under various laws, plans, and programs, the Council should consider adopting this framework.

- **Table 3** Outline of Performance Tracking and Reporting

• Performance Targets	• Performance Standards	• Monitoring	• Reporting
	• **Fish Population Metrics**		
• Positive trends in abundance	•	• Context for prioritization of actions and adaptive management needs	• Comprehensive Evaluations [using NMFS Biological Review Team (BRT) Status Report]
	• **Hydrosystem**		
• Percent system survival – by ESU or DPS	•	• Juvenile Passage RM&E and System Survival Modeling	• Comprehensive Evaluations
	• Hydrosystem Action Programmatic Standards	• Project Implementation and Compliance Monitoring	• Annual Progress Reports and Comprehensive Evaluations

[6] *Id.* at page 2-9.

	• Juvenile Dam Survival Standards (96 percent average for spring migrants and 93 percent average for summer migrants)	• Juvenile Passage Monitoring and Dam Survival Modeling	• Comprehensive Evaluations
• Flow, gas, and temperature levels (adjusted to reflect annual and seasonal water conditions)	• Juvenile and Adult Hydrosystem Environmental and Physical Configuration Standards	• Environmental Monitoring at Mainstem Dams	• TMT Annual Water Management Plan Reports
	• Adult Hydrosystem Survival (no significant change from current average survival levels)	• Adult System Survival Monitoring	• Annual Progress Reports and Comprehensive Evaluations
• **Tributary Habitat**			
• Percent habitat quality improvement – by population for actions implemented from 2007 through 2017	•	• Intensively Monitored Watersheds, Status Monitoring, and Project-Level Monitoring informs and updates modeling	• Comprehensive Evaluations
	• Tributary Habitat Action Programmatic Standards (3-year cycle)	• Project Implementation and Compliance Monitoring	• Annual Progress Reports and Comprehensive Evaluations
• **Estuary Habitat**			
• Percent function improvements for Stream Type and Ocean Type ESUs for actions through 2007 and through 2017	•	• Status Monitoring and Project-Level Monitoring informs and updates modeling	• Comprehensive Evaluations
	• Estuary Habitat Action Programmatic Standards	• Project Implementation and Compliance Modeling	• Annual Progress Reports and Comprehensive Evaluations

• **Hatchery**			
• Low, Medium or High benefits relative to objectives – by target populating	•	• Status Monitoring and Project-Level Monitoring and updates Lifecycle Modeling	• Comprehensive Evaluations
	• Hatchery Action Programmatic Standards; site-specific BMPs	• Project Implementation and Compliance Monitoring	• Annual Progress Reports and Comprehensive Evaluations
•	•	•	•
• **Predation**			
• Percent survival increase for spring and for summer migrants	•	• Predation Action Effectiveness Research and Status Monitoring	• Comprehensive Evaluations
	•	• Predation Exploitation rates	• Comprehensive Evaluations
	• Predation Action Programmatic Standards	• Project Implementation and Compliance Monitoring	• Annual Progress Reports and Comprehensive Evaluations

Section C: Summary of the ISAB's Climate Change Findings[7]

Potential Impacts to Hydrology and Temperatures

Climate change could have the following potential biological effects on the Columbia River Estuary and the Pacific Ocean:

- For immigrating adults, an increase in ocean temperatures could lead to a loss in energy reserves because of increasing metabolic demand.
- Forecasts suggest higher average Columbia River flows in winter and early spring flows, and less snowmelt in summer in future years. It is reasonable to expect that any increase in freshwater temperatures will result in warming in the estuary.

[7] ISAB, Climate Change Impacts on Columbia River Basin Fish and Wildlife (document 2007-2) (2007).

- On a global scale, increased upper ocean temperatures have been documented to reduce primary productivity since 1997.
- Of primary interest in the Pacific Northwest, the growing mismatch of coastal upwelling and smolt migrations would likely have significant negative impacts on marine survival rates. Warmer sea temperatures require increased prey consumption to maintain a given growth rate. This could delay the time when populations return to fresh water to spawn.

The ISAB made following key findings regarding potential effects from climate change on salmonids in the mainstem Snake and Columbia rivers:

- Increases in water temperature will accelerate the rate of egg development and lead to earlier emergence from mainstem redds, most likely at a smaller average size than historically. Smaller-sized fry may have lower survival due to increased vulnerability to predators.
- Predation on salmonids may be increased by elevated water temperatures. Warmer temperatures may reduce the size of smolts. Elevated water temperatures also will increase consumption rates and growth rates of predators.
- Warmer water temperatures may exclude salmonids from reaches with temperatures that are already close to their upper thermal limit. Metabolic rates will increase, leading to reduced growth rates where food is limited and smaller size at the end of the summer.
- Many fish pathogens and parasites common in the environment and their salmon hosts may increase mortality when smolts become thermally stressed.
- Potential impacts of increased water temperatures on adult salmon include delay in dam passage, failure to enter fish ladders, and loss of energy reserves due to increased metabolic demand.
- Numerous warm-water adapted fish, including several non-indigenous species, normally found in freshwater may expand their populations with the warmer water and seasonal expansion of freshwater habitats.

Changes in hydrology will affect tributary habitats in those watersheds where snow levels are impacted. Watersheds that are just above the current snow line currently may experience a change from a snowmelt-dominated hydrologic regime to one that is driven primarily by rainfall or rain on transient snow pack. Even those watersheds that remain above the snow line will experience earlier snowmelt runoff. These changes in hydrology all may affect salmonid productivity. Some of the highest quality aquatic habitat remaining in the

Columbia River Basin is found in forested areas. Forests lost to fire and insect outbreaks will disproportionately impact key habitats for fish and wildlife.

Potential effects on egg incubation and fry emergence in tributaries areas can include:

- Increased maintenance metabolism will produce smaller fry;
- Lower disease resistance may lead to lower survival;
- Faster embryonic development will lead to earlier hatching; and
- Increased mortality due to more frequent flood flows as snow level rises

Increased frequency and severity of flood flows during winter can affect over-wintering juvenile fish and eggs incubating in the streambed and elsewhere. Shifts in the timing and magnitude of natural runoff will likely introduce new selection pressures that may cause changes in the most productive timing or areas for spawning.

Potential effects on spring/summer rearing can include:

- Lower summer/early autumn flow will reduce habitat area,
- Cold-water species may be excluded from areas currently occupied,
- Lower growth due to increased metabolic rate (if food is limited),
- Competitive advantage from non-native and warm-water species,
- Increased predation mortality if temperatures exceed optimal levels, and
- Fish in streams with very cold water may benefit (high elevations).

Potential effects on over-winter survival can include:

- Potential for positive and negative effects;
- Higher water temperature increases metabolic rate and activity:
    - Higher growth rate with sufficient food
    - Lower growth rate if food is limiting;
- Higher predation rates; and
- Increased frequency and severity of winter high flow will have detrimental effects.

Section D: Standard Definitions of the Types of RM&E Projects

The following definitions of types of research, monitoring and evaluation are consistent with ongoing RM&E planning and coordination processes. BPA will use them with the PISCES database structure for submittal of proposals and subsequent management of selected projects:

1. Fish/Wildlife Population and/or Environmental Status and Trend Monitoring – census or statistically designed monitoring of fish or wildlife population and/or environmental conditions (i.e. watershed conditions) to assess the current status or change (trend) over time. This is sometimes referred to as an observational study (ISRP, 2005). These monitoring data may also be used to correlate fish performance with environmental conditions.

    - Ecosystem/Landscape level, broad-scale, periodic monitoring (referred to as Tier 1 Monitoring)
    - Geographically localized, frequent monitoring (referred to as Tier 2 Monitoring)

2. Action Effectiveness Research – research to determine the effects of an action or suite of actions on fish survival, productivity and/or habitat conditions (referred to as Tier 3 monitoring). This is a manipulative experiment that statistically assesses the effect of a treatment (action) condition relative to a control or reference condition. Action effectiveness research can be performed for a localized effect (project or stream reach level effect) or for a watershed level effect (intensively monitored effect). Localized (project level) effects most commonly identify changes in habitat conditions associated with the action, while fish or biological responses may require a watershed level (intensively monitored approach) to capture a broader area in which a biological response is expressed.

3. Uncertainties Research – research to resolve scientific uncertainties regarding the relationships among fish or wildlife health, population performance (abundance, survival, productivity, distribution, diversity), habitat conditions, life history and/or genetic conditions (e.g., the existence and causes of delayed mortality, hatchery spawner reproductive success relative to wild populations, etc.). This is a manipulative experiment where variables are manipulated to infer or demonstrate cause and effect relationships using statistical-designed hypothesis testing. Uncertainties research does not include experimental research and monitoring specifically

targeting the effect of a mitigation or restoration action (this is Action Effectiveness Research). It also does not include monitoring (observational studies) of fish or habitat conditions with inferences from statistical correlation assessments (this is Status and Trend Monitoring).

4. Project Implementation and Compliance Monitoring – monitoring the execution and outcomes of projects. This type of monitoring does not require environmental response data directly linking restoration actions to physical, chemical, or biological responses.

- *Project Implementation* monitoring determines whether projects were carried out as planned, through documentation of the type and location of management action, and whether the action was implemented properly or complies with established standards. This is generally carried out as an administrative review and does not require any parameter measurements beyond those specified by the project design requirements. It is usually a low-cost monitoring activity that should be included for all mitigation activities.

- *Project Compliance* monitoring determines whether specified project criteria are being met, through a post-project auditing of project performance. This type of monitoring would typically not be carried out by the project sponsor, and may require the development of independent, compliance monitoring projects. A limited, statistical-designed sample of projects could be monitored annually for compliance.

Section E: Kinds of Coordination

Embedded Coordination

Many habitat and other projects contain coordination work elements. Such coordination is not, ultimately, on-the-ground action that conveys direct biological or environmental benefits to fish and wildlife. Since BPA and the Council have focused on programmatic categorizations derived from project-level characterizations (i.e., the principal thrust of project purposes viewed in its entirety), this type of coordination spending is generally not included in the 5 percent programmatic target for coordination and data management.

Watershed Coordination

BPA supports several watershed-based coordination functions through projects that are included in the 5 percent target. The purposes of these projects vary; however, several were originally initiated as pilot demonstrations or "models" 10 or more years ago, at a time when few resources were available to facilitate in

the development, or prove-up on the merits, of watershed-based planning and implementation. In the intervening years, as each state has developed management structures and a network of support and resources for watershed-based action and investment, the concept and approach has matured beyond the need for models or further demonstrations. The more BPA spends to "coordinate" the activities of others, the less funding is available for mitigation efforts that both directly address the limiting factors for fish and wildlife, and that can be counted as progress toward BPA's mitigation responsibilities through measured performance based on biological objectives. The Program should phase out these costs.

Regional Coordination

BPA has funded some broad regional coordination projects, the intent of which was to support a forum through which fish and wildlife managers could build consensus recommendations to the Council regarding the development of the Program. While regional input remains important for developing the most biologically effective Program, new coordinating entities, and membership changes in older ones necessitate reconsidering the most appropriate way for BPA to support regional coordination efforts. The effectiveness of fish and wildlife manager coordination is a critical consideration, particularly given that this coordination work does not directly facilitate the implementation of on-the-ground benefits like the other two coordination categories BPA supports, discussed above. To ensure that regional coordination activities achieve the objectives set in the Act and the Program, BPA encourages the Council to facilitate further discussions among appropriate entities, outside of the amendment process, to revise its recommendations on regional coordination.

Those further discussions should consider that under the new FCRPS biological opinion, the Action Agencies will coordinate RM&E activities with other federal, state, and tribal agencies on an ongoing annual basis, including:

- Organizing and supporting the Corps' Anadromous Fish Evaluation Program.
- Supporting and participating in the Council's Columbia River Basin Fish and Wildlife Program project planning and review efforts.
- Supporting the standardization and coordination of tagging and monitoring efforts through participation and leadership in regional coordination forums such as the Pacific Northwest Aquatic Monitoring Partnership.
- Working with regional monitoring agencies to develop, cooperatively fund, and implement standard metrics, business practices, and

information collection and reporting tools needed to cooperatively track and report on the status of regional fish improvement and fish monitoring projects.

• Coordinating the further development and implementation of hydrosystem, tributary habitat, estuary/ocean, harvest, hatchery, and predation RM&E through leadership and participation in ongoing collaboration and review processes and workgroups.

• Coordinating implementation with other appropriate regional collaboration processes. This includes coordination related to statutory provisions for the federal government (BPA/Council), voluntary coordination among federal agencies (Federal Caucus), and coordination with regional processes for federal/nonfederal engagement (TMT, SCT, PNAMP, NED, and others).

- NED, PNAMP and PNW-RGIC managers and coordinators should develop and implement a regional executive level memorandum of understanding or similar instrument to:
    - Identify priority information sharing needs;
    - Improve information sharing and complete a regional ecosystem and information framework;
    - Develop indicators, information collection standards, and protocols and information sharing arrangements;
    - Develop an executive leadership group to steer this effort and other necessary organizational and administrative arrangements including consideration of roles for NED, PNAMP and PNW-RGIC;
    - Identify resources for these tasks; and,
    - Set overall timelines and review progress.

Section F: Annualizing Wildlife Habitat Losses

Annualization requires three steps. The first step, typically done before project construction begins, estimates the "without dam" habitat quality and quantity. The Habitat Evaluation Procedure process and annualization weren't developed until the late 1970s, so this wasn't possible with the FCRPS projects. Instead, for each habitat type inundated, wildlife managers imagined what would have happened to that habitat if the dams had not been built.

The second step, often called "backcasting," involves guessing what changes would occur to the habitat in each successive year. Like computer programmers developing a virtual world, resource managers would use their unique expertise

to visualize the hypothetical impacts from floods, plagues, fires, droughts, pestilence, climate change, harvest impacts, agriculture, mining, logging, road building and other development on each species and habitat type. This is done for each year from project construction until present.

For instance, Grand Coulee Dam inundated a number of orchards. For each year since construction, an annualization exercise would require that wildlife managers fathom the international apple markets, the rise of viticulture in the Northwest, and conjecture about how the orchard industry might have changed in that area. To construct Libby Dam, several roads, railroads, and small towns were relocated. To annualize those losses, assumptions would need to be made about the towns' changes annually, since dam construction to present.

The final annualization step is the "with dam" analysis. In addition to inundating habitat, a new reservoir establishes, among other things, a new shoreline on a landscape that previously was dry habitat. Over time, this new shoreline may create new wet meadows or possibly a new riparian area. Again, year by year since construction, the process would need to assess what benefits the new reservoir created for wildlife.

The "with dam" outcome is subtracted from the "without dam" outcome—for each year from pre-dam construction to present. Then the results for all the years are averaged; that is, annualized. Compared to the single point in time assessments like those in the Program, annualized losses may result in either higher or lower losses—and gains.

Section G: Wildlife Habitat Cover Type/Species Matrix Explanation

A cover type/species matrix is a table that displays impacted and/or compensation area cover types and HEP model species used to evaluate habitat quality on those cover types. The viewer is able to quickly identify loss assessment or compensation project cover types, determine the HEP model species used to assess habitat quality, and tally the number of HEP models/species applied to each cover type.

HEP MODEL	THE DALLES DAM COVER TYPE/SPECIES MATRIX					
	Rip. Tree	Rip. Shrub	Sand/Gravel/ Cobble/Mud	Shrub-steppe/ Grassland	Islands	Open Water
Canada Goose					X	
Spotted Sandpiper			X			
Mink	X	X				
Western Meadowlark				X		
Black-capped Chickadee	X					
Yellow Warbler		X				
Great Blue Heron			X			
Number of HEP Models per Cover Type	2	2	2	1	1	0

Section H: Implementation Strategies for the Willamette Subbasin

1. Coordinate the "on-site" investments called for in the Willamette biological opinions with "off-site" habitat improvement work done for fish or wildlife. The opinion aim primarily at operational and structural changes at the dams, but the draft recovery plan also identifies juvenile rearing as a key limiting factor. Off-site improvements aimed at floodplain reconnection will address key scientific principles of the Program such as the need to address various spatial scales and the importance of life history diversity as a buffer to environmental variation.[8] Restored rearing habitat should help reestablish the native subyearling life history strategy for chinook.
2. Reform hatchery management practices consistent with the findings from the HSRG review. The NOAA Fisheries Willamette biological opinion will address some hatchery management concerns, but attention should also be paid to the completion and implementation of the hatchery genetic management plans for chinook and steelhead as well.
3. Protect the McKenzie River spring chinook population. While both winter steelhead and spring chinook are listed throughout the Willamette basin, the McKenzie spring chinook population remains relatively strong and represents an important element in the genetic legacy of the Upper Willamette ESU. Habitat improvement and hatchery management should make protecting this strong population a key objective.

[8] Council, 2000 Program at 15.

4. Explore and adopt as appropriate one or more of the following ways of approaching mitigation that reflect the Willamette Subbasin's unique social, economic, and biological conditions.
    a. Implement a model watershed approach to habitat improvement. This model has been successful in the Grande Ronde and the Columbia estuary. Develop project selection criteria specific to the Willamette based on limiting factors and strategies outlined in the draft recovery plan, the subbasin plan, the Oregon Conservation Plan, and the Willamette Floodplain Restoration Study. Design effectiveness monitoring programmatically, balancing the ISRP's call for better reporting of results and BPA's concern for emphasizing "on the ground" work.
    b. Combine with other state and federal agencies and non-profit groups to coordinate a pulse of new mitigation initiatives and investments to create a significant beneficial cumulative impact as a preemptive effort to offset forecast climate and human impacts.
    c. Coordinate habitat improvement activities with the Corps. The Corps expects to implement additional habitat restoration as part of the Willamette biological opinions. Where economically and biologically feasible, explore partnerships that help leverage Corps funding.
    d. Partner with public land owners such as Oregon Department of State Lands. It holds significant amounts of land along the Willamette floodplain and has expressed an interest in managing its lands with an increased emphasis on fish and wildlife.
    e. Focus actions on improving and protecting ecosystem function to provide benefits for multiple species. In particular, riparian and floodplain improvements can potentially benefit juvenile salmon and enhance cover types needed for wildlife mitigation. The U.S. Fish and Wildlife Service identified flood plain reconnection as a key strategy for recovering listed Oregon chub.[9] Several projects—such as Lost Creek, Big Island, and Green Island—already take the ecosystem approach and provide recognized benefits for both fish and wildlife.[10]
5. Pursue innovative, market-based approaches to habitat protection. Partner with working forests and farms and use existing and emerging markets—such as those in sustainable forestry and carbon sequestration—

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[9] U.S. Fish and Wildlife Service, Oregon Chub Recovery Plan (1998).
[10] Pope, M., Willamette Wildlife Mitigation Annual Report (2005).

to protect habitat. Consider projects integrated with or modeled after the Oregon Department of Transportation's conservation banking Program,[11] the Willamette Partnership's Willamette Ecosystem Marketplace,[12] or the Teton Regional Land Trust's conservation land buyer Program.[13]

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[11] Oregon Department of Transportation, Statewide Banking Program: Final Agreement (2004).
[12] Primozich, D., and Vickerman, S., Willamette Ecosystem Marketplace (2007).
[13] Information at http://www.tetonlandtrust.org/index.html