No. 17-269

In The
Supreme Court of the United States

STATE OF WASHINGTON,

Petitioner,

v.

UNITED STATES OF AMERICA, ET AL.

Respondents.

ON WRIT OF CERTIORARI
TO THE UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

JOINT APPENDIX – VOLUME III OF III

ROBERT W. FERGUSON
Attorney General
NOAH G. PURCELL
Solicitor General
Counsel of Record
1125 Washington Street SE
Olympia, WA 98504-0100
360-753-6200
noah.purcell@atg.wa.gov
Attorneys for Petitioner

JOHN C. SLEDD
Counsel of Record
Kanji & Katzen, PLLC
401 2nd Avenue S Suite 700
Seattle, WA 98104
206-344-8100
jsledd@kanjikatzen.com
Counsel for Respondent Tribes

NOEL J. FRANCISCO
Solicitor General
Counsel of Record
Department of Justice
Washington, D.C. 20530-0001
202-514-2217
supremectbriefs@usdoj.gov
Counsel For United States

PETITION FOR CERTIORARI FILED AUGUST 17, 2017
CERTIORARI GRANTED JANUARY 12, 2018

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THE HONORABLE RICARDO S. MARTINEZ

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF WESTERN WASHINGTON AT SEATTLE

UNITED STATES OF AMERICA, et al., Plaintiffs, vs. STATE OF WASHINGTON, et al., Defendants.	Case No.: 70-9213 Subproceeding No. 01-1 (Culverts) ***REVISED* DECLARATION (Oct. 13, 2009) OF PHILLIP A. MEYER REGARDING PRE-FILED, WRITTEN DIRECT TESTIMONY**

I, Philip A. Meyer, hereby declare as follows:

1. I am over the age of eighteen and am competent to testify on the matters set forth herein.

2. I hold a B.A. degree in Economics and Political Science from the University of British Columbia, and an M.A. in Resource Economics from the University of California, Santa Barbara. I have been employed as an economist for more than forty years, specializing in natural resource and particularly fisheries economics. I have previously been qualified as an expert witness and testified in several matters including the Shellfish Subproceeding in *United States v.*

Washington, Civil No. 9213, Sub. 89-3. A true copy of my *curriculum vitae* is attached to this declaration.

3. I was asked by counsel for Plaintiff Tribes in this sub-proceeding to testify as a witness son behalf of the Tribes. My direct testimony is in the form of a written report entitled "Estimation of Economic Benefits from Added Salmon and Steelhead Production in the State of Washington. A true and complete copy of my report is incorporated herein and constitutes testimony I would give in open court.

4. Attached and incorporated by reference herein is my revised report dated October 13, 2009, in lieu of direct testimony which report contains testimony I would give under oath if offered in open court.

I DECLARE under penalty of perjury that the foregoing is true and correct.

Executed this 13th day of October, 2009, at Victoria, Canada.

By: [signature]
Philip A. Meyer

Estimated Marginal Net Economic Benefits Associated with Salmon and Steelhead in the State of Washington

A Report to:

MORISSET, SCHLOSSER & JOZWIAK

A Report by:

Philip A. Meyer

October 13, 2009

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Marginal Net Economic Benefits Associated with Salmon and Steelhead in the State of Washington

I. Introduction.

A 2008 report released by the Washington Department of Fish and Wildlife in December attributes $9.5 million annually in ex-vessel payments to Washington non-tribal commercial salmon fishermen[1], and net economic values of $129.4 million annually to recreational salmon fishers and $51.3 million to persons fishing recreationally for steelhead[2] in waters of Washington State.

[redacted]

REDACTED 10-15-2009 TRIAL TRANSCRIPT AT p. 47 (MDM)

Tribal values associated with returning salmon extend well beyond dollar returns to commercial fishing[6].

This report presents estimates of marginal[7] net economic benefits associated with salmon and steelhead stocks in the State of Washington only. The *marginal unit* utilized here for analysis is *one adult salmon or steelhead.* Extant an estimate of expected salmon returns to obtain an indication of scale, *existence/passive use* benefits are not incorporated in following sections of this report. Information on benefits to tribes – beyond those that would accrue from commercial fishing – is also not presented here.

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[1] TWC Economics, 2008. **Economic Analysis of the Non-Treaty Commercial and Recreational Fisheries in Washington State.** A Report for Washington Department of Fish and Wildlife, p. 7.

[2] Supra at 18

[redacted]

SEE ABOVE (MDM)

[6] See, for example: Central Washington University, 1991. **Potential Effects of OCS Oil and Gas Exploration and Development on Pacific Northwest Indian Tribes: Final Technical Report.** A Report to the U.S. Minerals Management Service. MMS 91-0056.

[7] In economics, "at the margin" means at the point where the last unit is added to or subtracted from production, or consumption.

II. Net Economic Revenue to Tribal and Non-Tribal Commercial Fishermen and Processors from Increased Returns of Salmon and Steelhead.

Assessment of *net economic value* associated with commercial salmon/steelhead harvesting and processing is the appropriate measure of economic impact from a national economic perspective.[8] *Net economic value* from increased commercial harvest and processing of salmon refers to the added money revenue gained by these activities, minus any additional associated costs.

Employment of otherwise unemployed labor resources is to be treated as a net economic benefit, not a cost[9], in such assessment. In applied terms, this requirement instructs that costs associated with labor, taken from a labor pool that is otherwise substantially and persistently unemployed, should not be deducted from net economic value[10].

This report follows federal guidelines, and calculates the net economic value for a commercially harvested salmon, based on procedure used in National Marine Fisheries Service et al. (2004).[11] The following steps are employed.

a. Estimate average price per salmon received by commercial fishermen.

b. Subtract any relevant associated fishermen cost to obtain net economic value at the fishermen level.

c. Apply a net value markup from the price received by fishermen to incorporate salmon processing in the calculation.

Prices per salmon in this analysis are obtained from the tribal component of the joint Washington State/ NWIFC commercial catch statistics data base – and represent averages for 2007/2008[12].

At the U.S. Decennial Census (2000), unemployment rates for case tribes were relatively high – ranging from 7 percent to 23 percent[13]. Overall, unemployment rates reported for Washington State residents were lower – but unemployment for the fishing sector was estimated above 20 percent in coastal counties[14].

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[8] U.S. Water Resources Council, 1983. **Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.** Washington, D.C., U.S. Superintendent of Documents.

[9] **Supra** at 93.

[10] National Marine Fisheries Service, Puget Sound Tribes and Washington Department of Fish and Wildlife, 2004. **Puget Sound Chinook Harvest Resource Management Plan: Final Environmental Impact Statement**. Appendix D, Attachment C. p. 1

[11] **Supra**.

[12] Prices obtained by non-tribal commercial fishers may vary somewhat from those obtained by tribal fishers, according to gear employed and variant spot market conditions.

[13] U.S. Bureau of the Census, 2004. **Characteristics of Individuals in a Specified American Indian Tribe – 2000**. STP-14. Census 2000 special tabulation.

[14] Wegge, Tom. 2003. *Estimated Unemployment Rates for Fishing Industry.* Cited to Washington State Employment Security Department, 2002, 2003. Email at August 29, 2003.

Washington State Employment Security Department identified the overall state unemployment rate increasing to 6.5 percent in 2008.[15] Present economic circumstances indicate that unemployment in the state (inclusive of the more adverse tribal and non-tribal fishing sectors) has increased further.[16]

Finally, NMFS et al (2004) employed a 100 percent markup for salmon from landed (ex-vessel) value through processing – and a reduction of 50% of this increment to allow for associated processing costs.[17]

Considering this information, it is concluded that the percentages applied to gross fishing revenue to obtain estimated *net economic value* by National Marine Fisheries, Tribes and the State of Washington in 2004[18] retain validity. These percentages will be used here (Table 1)[19] – expressed as a portion of the total value amount at respective fishing and processing stages.

Table 1

Net Economic Value Coefficients for Commercial Fisheries and Processing - Added Harvest of Salmon and Steelhead –

Measure	Net Economic Coefficient*	Economic Value (baseline = $1.00)
Gross Revenue Return to Fishing		1.00
Net Economic Return to Fishing	Gross fishing revenue x .94	.94
Net Economic Return to Processing	Gross fishing revenue x .50	.50
Net Economic Return to Fishing & Processing	Gross fishing revenue x 1.44	1.44

*The *net economic coefficient* represents the proportion of each dollar received by a fisher or processor that is counted as *net economic value* under the procedures discussed in this report. *Net economic values* at fishing and processing stages are additive.

Table 2 provides estimates of the net economic value per salmon accruing annually to Washington commercial fisheries and processors from additional harvest of salmon and steelhead. These values are obtained by applying average 2007/2008 prices for tribal

[15] Washington State Employment Security Department, 2008. **2008 Washington State Labor Market and Economic Report.** p. 3.
[16] Washington State Employment Security Department, 2009. **Workforce Explorer: Washington.** January. Downloaded March 9.
[17] National Marine Fisheries Service et al. 2004. **Supra.** Appendix D, Attach. C, p. 8.
[18] **Supra.**
[19] The net economic coefficient for non-tribal commercial fishers has been increased slightly (by .04%) in this report, to conform to the tribal coefficient. This adjustment is consistent with final figures used by National Marine Fisheries Service et al. 2004.

inside and outside harvests – and modifying these results by the net economic value coefficients (Table 1).

Net economic values associated with further markup of salmon and steelhead revenues to retails levels are not included in this report. Such further value increments can be substantial.[20]

Table 2

Net Economic Value to Washington Commercial Fishers and Fish Processors from Return of One Additional Salmon or Steelhead

Species	Harvest Price Per Salmon	Net Economic Value Per Salmon – Fishing & Processing -
Chinook	**$53.30**	**$76.75**
Chum	**6.50**	**9.36**
Coho	**14.90**	**21.46**
Pink	**.96**	**1.38**
Sockeye	**11.40**	**16.42**
Steelhead	**21.23**	**30.57**

III. Net Economic Value Associated with Additional Sport Catch of a Salmon.

For several decades[21], estimates of *consumer's surplus* have been widely used to determine net economic value associated with goods and services.

> (Consumer's surplus) is a measure of the benefit to a consumer, net of the sacrifice he has to make, from being able to buy a commodity at a particular price. It is widely used in cost-benefit analysis and other areas of applied economics as an appropriate measure of changes in welfare… .[22]

The US Water Resources Council (1983) recommended that, where direct market prices for recreational goods and services were unavailable, *consumer's surplus* could be determined by two applied methods. The *travel cost* method counts the number of visitors to a given recreational site as a function of cost associated with distance and travel time. The second basic pricing method is via *contingent valuation survey,* which directly asks

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[20] See, National Marine Fisheries Service, 2009. **Fisheries of the United States 2006.** Silver Spring, MD. U.S. Department of Commerce, pp. 38, 40.

[21] See, for example; Willig, Robert D., 1976. *Consumer's Surplus Without Apology,* in, **The American Economic Review.** September, pp.589-597.

[22] Pearce, David W., 1992. **The MIT Dictionary of Modern Economics** (4th edition). Cambridge, Mass: The MIT Press, p. 78.

respondents how much they would be *willing to pay* for changes in the quantity or quality of resources or of recreational opportunities[23], [24]

Where available researcher time and/or financial resources does not justify a field study to determine *consumer's surplus* via *travel cost* or *contingent valuation survey,* the Water Resources Council certified a third procedure – initially called the *unit day value method,* based on examination of prior empirical work and best expert judgment.[25] Such transfer of values from prior work continues to the present day – and is now commonly termed *benefit transfer analysis* by economists.

> Generally, nonmarket values are estimated through original research using methods such as the contingent valuation method or the travel cost method. The increasingly rich literature of valuation studies, combined with theoretical innovations, created the opportunity for less expensive and less time-consuming approaches to value estimation—a variety of techniques that can be described as benefit transfer.[26]

Given the time and financial resources available to this report, *benefit transfer analysis* is employed here. Two previous analyses are considered: National Marine Fisheries Service, Puget Sound Tribes and Washington Department of Fish and Wildlife (2004); and TCW Economics (2008)[27]. These two studies meet requisite "goodness of fit" criteria for transfer of value results – namely, they were done by recognized experts, and for federal/state agencies with fishery management responsibility in the waters of Washington State. Their reported results also provide data specific to salmonids.

National Marine Fisheries Service et al. (2004) estimated the *average net economic value of sport fishing in Puget Sound waters (including tributaries)* at $65 per angler day[28], expressed in Year-2000 dollars – based on earlier survey data from Olson et al., (1991)[29]. TCW Economics (2008) estimated a 2006 net economic value for sport fishing for salmon in Washington State of $58 per angler day[30] - based on a survey of prior salmon sport fishing studies in the Pacific region by Boyle et al. (1998)[31]. The lower TCW estimate of $58 per angler day is more recently published. It will be employed here.

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[23] US Water Resources Council, 1983. **Supra** at 67-83.

[24] For a more extensive treatment of scholarly discussion of *contingent value survey* methods, see: Mitchell, Robert C., and R.T. Carson, 1989. **Using Surveys to Value Public Goods: The Contingent Value Method.** Washington, D.C: Resources for the Future. The Johns Hopkins University Press.

[25] US Water Resources Council, 1983. **Supra** at 83-87.

[26] Allen, Byron P. and J.B. Loomis. *The decision to use benefit transfer or conduct original valuation research for benefit-cost and policy analysis.* in, **Contemporary Economic Policy**. 01-Jan-08.

[27] TCW Economics, 2008. **Supra**. p. 19.

[28] National Marine Fisheries Service et al., 2004. **Supra** at D-49.

[29] Olsen, D., J. Richards and R.D. Scott, 1991. *Existence and Sport Values for Doubling the Size of Columbia Basin Salmon and Steelhead Runs.* **Rivers**. Vol. 1, No. 1, pp. 44-56.

[30] TCW Economics, 2008. **Supra** at 19.

[31] Boyle, Kevin, R. Bishop, J. Caudill, J. Charbonneau, D. Larsen, M. Markowski, R. Unsworth, and R. Paterson, 1998. **A Data Base of Sport Fishing Values.** U.S. Fish and Wildlife Service. Economic Division.

Dividing aggregate "net economic value" figures for salmon and steelhead, reported in TCW Economics' Table 8, by recreational salmon and steelhead harvest figures from TCW's Table 6, yields an estimate of net economic value *per sport salmon* harvested (Table 3).

Table 3

Net Economic Value from an Added Sport Caught Salmonid

Species	Net Economic Value Per Fish
	---dollars per fish---
Salmon	$460.15
Steelhead	$470.73

IV. Present Value from an Additional Salmon or Steelhead Returning to Washington State – Summed Over 50 and 100 Years.

The average annual net economic benefit from an additional adult salmonid returning to Washington State is expected to accrue, year after year, over future time. Standard practice requires economists to sum such annual benefits over a future period of up to 100 years[32]. For this analysis, such summed values are reported for periods of 50 and 100 years into the future.

Economists note that benefits accruing in the future may not be assigned equivalent value with those accruing at present – either because persons may prefer to consume goods or services "now" rather than "later" (social time preference), or because presently available funds could be invested to earn a future economic return (rate of return on capital). Consequently, economists progressively reduce weightings applied to annual estimated net economic value over each future year by use of a real rate of discount[33] - and then sum these discounted annual values to obtain an estimate of the *total present value* of benefits received.

[32] US Water Resources Council, 1983. Supra at 5.
[33] *Real discount rates* discount the value of benefits received in future years, minus any effects from expected future inflation.

Issues associated with selection of an appropriate discount rate have been extensively discussed in Lind, et al. (1982)[34]; and by Hartman (1990)[35], Lind (1990)[36], Lyon (1990)[37] and Moore and Viscusi (1990)[38]. Charles Howe, chair of the special JEEAM (1990) session on discounting[39] summarized consensus from the four papers.

> Under current U.S. conditions, a real rate (of discount) of about 2% seems to have support…[40]

In analyses such as this, where benefits are expected to accrue well into the future:

> The government's long term borrowing rate is a good first candidate for the discount rate in long-term intergenerational allocation problems.[41]

The U.S. Office of Management and Budget, in their circular of December, 2008, recommend use of a real discount rate of 2.7% for future annual benefits lasting thirty years or more.[42]. That rate is employed here to estimate the discounted present value of benefits accruing to fishers, fish processors and to Washington State residents in general, from an added returning salmon and steelheads – summed over 50 years and 100 years, respectively (Table 4).

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[34] Lind, Robert C., K.J. Arrow, G.B. Corey, P. Dasgupta, A.K. Sen, T. Stauffer, J.E. Stiglitz, J.A. Stockfish and R. Wilson, 1982. **Discounting for Time and Risk in Energy Policy**. Resources for the Future. Washington, D.C.: John Hopkins Press.
[35] Hartman, Robert W., 1990. *One Thousand Points of Light Seeking a Number: A Case Study of CBO's Search for a Discount Rate Policy,* in, **Journal of Environmental Economics and Management**, 18, S-3 to S-7.
[36] Lind, Robert C. 1990. *Reassessing the Government's Discount Rate Policy in Light of New Theory and Data in a World Economy with a High Degree of Capital Mobility,* in, **Journal of Environmental Economics and Management**, 18, S-8 to S-28.
[37] Lyon, Randolph M., 1990. *Federal Discount Rate Policy, the Shadow Price of Capital, and Challenges for Reforms,* in, **Journal of Environmental Economics and Management,** 18, S-29 to S-50.
[38] Moore, Michael J. and W.K. Viscusi, 1990. *Discounting Environmental Health Risks: New Evidence and Policy Implications,* in, **Journal of Environmental Economics and Management**. 18, S-51 to S-62.
[39] Notes 44 through 47.
[40] Howe, Charles C., 1990. *Introduction: The Social Discount Rate,* in, **Journal of Environmental Economics and Management**, 18, S-2.
[41] Lind, Robert C., 1990. **Supra** at S-24.
[42] Executive Office of the President, 2008. **2009 Discount Rates for OMB Circular No. A-94.** Office of Management and Budget. December 12.

Table 4

Present Value of Salmon-Related Benefits from an Additional Salmon or Steelhead Returning to Washington State Each Year - Summed Over 50 and 100 Years at a Real Discount Rate of 2.7% -

Beneficiary	Annual Net Benefit Per Fish	Total - 50 Years	Total - 100 Years
	---$--	---$---	---$---
Commercial Fishers & Processors:			
: Chinook	53.30	1,492	1,886
: Chum	6.50	182	230
: Coho	14.90	417	517
: Pink	.96	27	34
: Sockeye	11.40	319	403
: Steelhead	21.23	594	751
Sport Fishers:			
: Salmon	460.15	12,883	16,284
: Steelhead	470.73	13,180	16,658

V. References.

Allen, Byron P., and John B. Loomis, 2008. *The decision to use benefit transfer or conduct original valuation research for benefit-cost and policy analysis.* **Contemporary Economic Policy**. January 1, 2008.

Boyle, Kevin, R. Bishop, J. Caudill, J. Charbonneau, D. Larsen, M. Markowski, R. Unsworth and R. Patterson, 1998. **A Data Base of Sport Fishing Values**. U.S. Fish and Wildlife Service, Economics Division.

Central Washington University, 1991. **Potential Effects of OCS Oil and Gas Exploration and Development on Pacific Northwest Indian Tribes: Final Technical Report**. A Report to the US Minerals Management Service. Ellensburg, WA. MMS 91-00565.

Executive Office of the President, 2008. **2009 Discount Rates for OMB Circular No. A-94**. Washington, D.C: Office of Management and Budget. December 12.

Hartman, Robert W., 1990. *One Thousand Points of Light Seeking a Number: A Case Study of CBO's Search for a Discount Rate Policy,* in, **Journal of Environmental Economics and Management**, 18, S-3 to S-7.

THE HONORABLE RICARDO S. MARTINEZ

MORISSET, SCHLOSSER & JOZWIAK
1115 Norton Building
801 Second Avenue
Seattle Washington 98104-1509
Telephone: (206) 386-5200
Facsimile: (206) 386-7322

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF WESTERN WASHINGTON AT SEATTLE

UNITED STATES OF AMERICA, et al., Plaintiffs, vs. STATE OF WASHINGTON, et al., Defendants.	Case No.: 70-9213 Subproceeding No. 01-1 (Culverts) ***REVISED* DECLARATION (Oct. 13, 2009) OF KIT RAWSON IN LIEU OF DIRECT TESTIMONY** 28 U.S.C. § 1746

I, KIT RAWSON, hereby declares as follows:

1. I am the senior fishery management biologist for the Tulalip Tribes and have been a harvest management biologist for the Tulalip Tribes since 1986 and make this declaration in that capacity.

2. I have a Bachelor of Science degree in biological sciences from the University of Arizona (1975) and a Master of Science degree in biomathematics from the University of Washington (1980).

3. Prior to my employment with Tulalip I was a fisheries biometrician with the Alaska Department of Fish and Game for five years. I was a member of the Pacific Fishery Management Council's Scientific and Statistical Committee from 1991-1998. I was a member of the Puget Sound Technical Recovery Team from 2000 to 2007 and now am on the successor Puget Sound Recovery Implementation Technical Team. I am a Certified Fisheries Scientist with the American Fisheries Society.

4. I have been previously qualified as an expert witness and have testified on a number of occasions in *United States v. Washington*, both through live testimony and through affidavits and declarations.

5. Attached and incorporated by reference herein is my revised report dated October 13, 2009, in lieu of direct testimony which report contains testimony I would give under oath if offered in open court.

I DECLARE under penalty of perjury that the foregoing is true and correct.

Executed this 13th day of October, 2009, at The Tulalip Reservation, Washington.

By: Kit Rawson
Kit Rawson

UNITED STATES V. WASHINGTON - CAUSE NO. 9213 – SUBPROCEEDING 01-1 (CULVERT CASE)

WRITTEN REPORT AND DIRECT TESTIMONY OF KIT RAWSON

APRIL 3, 2009 TO ACCOMPANY DECLARATION OF APRIL 3, 2009

REVISED OCTOBER 13, 2009

1. Current status of Pacific salmon in the Puget Sound region

The rivers entering the greater Puget Sound region, including Puget Sound proper, Admiralty Inlet, the Whidbey Basin, and the United States side of southern Georgia Strait, the San Juan Islands, the Strait of Juan de Fuca supports six species of the genus *Oncorhynchus,* five species of Pacific salmon, plus steelhead. (Table 1).

Table 1. Species of Pacific salmon and steelhead (*Oncorhynchus* spp.) in Puget Sound with summaries of status under the Endangered Species Act (ESA) and the Salmon and Steelhead Stock Inventory (SASSI).

		ESA Status		SASSI Status			
Common name	Scientific name	Number of ESUs[a/]	Number endangered, threatened, or of concern[a/]	Number of stocks[b/]	Number of stocks rated[b/ c/]	Number of stocks rated as depressed or critical status[b/]	(%)[d/]
Chinook salmon	*O. tshawytscha*	1	1	29	22	12	(55%)
Chum salmon	*O. keta*	2	1	55	42	3	(7%)
Coho salmon	*O. kisutch*	1	1	46	37	17	(46%)
Pink salmon	*O. gorbuscha*	2	0	15	13	4	(31%)
Sockeye salmon	*O. nerka*	1	0	4	4	4	(100%)
Steelhead trout	*O. mykiss*	1	1	60	31	15	(48%)
Overall		8	4	209	149	55	(37%)

[a/] This counts ESUs with spawning grounds wholly or partially within the greater Puget Sound region. See http://www.nwr.noaa.gov/ESA-Salmon-Listings/.

[b/] See http://wdfw.wa.gov/fish/sassi/sassi92.pdf

[c/] Unrated stocks were classified as "unknown" status due to lack of sufficient information to make the assessment.

[d/] Percent of rated SASSI stocks that were in depressed or critical status.

I will discuss the current status of these species as related to what we can say about how their current status compares with their condition in a time before major impacts to habitat from converting land from forest to farms and cities, modification of shorelines, introduction of pollutants, modification of streamflow patterns, and blockages of access to habitat from dams and culverts.

A broad overview of salmon status is provided in the comprehensive review undertaken by the National Oceanic and Atmospheric Administration, Fisheries Division (NOAA Fisheries) in the late 1990s, for carrying out their mandates under the Endangered Species Act (ESA). They classified the Pacific salmon in Puget Sound into 8 evolutionarily significant units (ESU) [1], of which 4, or 50% are listed as endangered or threatened, or classified as "of concern" (Table 1)[2].

A more detailed assessment of Puget Sound salmon status is in the comanagers' (State of Washington and the treaty tribes) review of the status of all Washington salmon and steelhead in 1993. This analysis, in which I participated, resulted in a report called the Salmon and Steelhead Stock Inventory (SASSI[3]). The first step used available information on geographic location of spawning aggregations, average fish size, age structure, migration timing, and genetics to divide the species into stocks, or separate breeding populations. Pacific salmon biologists consider the stock to be the appropriate unit for conservation and for evaluating the status of a species. Those of us working on SASSI identified 209 stocks this way for all six species in the Puget Sound region (Table 1).

Our next step was to examine available information on trends in abundance and productivity to classify each of the stocks as "healthy", "depressed", or "critical." We classified a number of the stocks, lacking reliable abundance trend information, as "unknown" status. We assigned depressed status to stocks that are producing below levels that would normally be expected and critical status to stocks that are so low in abundance as to be biologically impaired by that fact alone. Although this isn't exactly the same thing, it is similar to an assessment that a group of fish may by threatened with or in danger of extinction. Of 149 Pacific salmon stocks in Puget Sound whose status we rated, 55, or 37% were either depressed or critical; of 22 rated Chinook salmon stocks, 55% were in these categories; of 37 rated coho salmon stocks, 46% were in these categories; and of 31 rated steelhead trout stocks, 48% were in these categories (Table 1).

Chinook, coho, and steelhead, the three species that most depend on a long period of rearing in freshwater streams and rivers[4], have the highest fraction of depressed and critical stocks in the SASSI analysis, with 49% of 90 rated stocks being either depressed or critical. Chum, pink, and sockeye, on the other hand, which do not require significant stream and

[1] The ESU is, for Pacific salmon, the equivalent of a "species" under the ESA and is the basic unit that is classified as endangered, threatened, or of concern.
[2] Of 52 ESUs on the entire west coast from Washington to California, 27 are now listed as threatened or endangered.
[3] http://wdfw.wa.gov/fish/sassi/sassi92.pdf
[4] C. Groot and G. Margolis (eds.). 1991. Pacific salmon life histories. University of British Columbia Press, Vancouver.

river rearing habitat[5] have 59 rated stocks in the Puget Sound region, of which we only rated 19% as depressed or critical.

By definition, and as will become clearer in the discussion of harvest management below, the SASSI depressed and critical stocks, and the ESA listed ESUs, are not able to provide direct fishery benefits from natural production at any level, or only at levels much less than what they likely provided under more pristine conditions of habitat. SASSI critical stocks and ESA-listed ESUs, in particular, must be managed with a primary goal of preventing further impairment or extinction. Although a combination of actions in the areas of harvest management, hatchery production, habitat protection, and habitat restoration is necessary for full recovery of salmon stocks, harvest management actions are typically the first and sometimes the only actions undertaken for conservation of depressed and critical stocks. But harvest reductions alone are not sufficient to increase salmon production, as recent experience shows. Lost habitat must be restored, and currently productive habitat protected, if these harvest reductions are to result in improved salmon production.

In SASSI , we classified the remaining rated stocks as healthy, but this classification is associated in the report with a strong caveat that "healthy" does not imply that these stocks are performing at levels similar to what they likely did under conditions of pristine habitat. In fact the report states "…if a stock status were rated against pristine habitat, every stock could be rated depressed or worse." [6] In fact, salmon biologists consider most naturally produced Chinook stocks in Puget Sound, whatever their SASSI rating, to be at abundances of between 10% and 25% of historical, pre-development, levels. This assessment is based on modeling of the relationship of habitat condition to Chinook salmon production for stocks throughout Puget Sound using the Ecosystem Diagnosis and Treatment (EDT) model[7]. There is no similar comprehensive analysis available comparing current status with pre-development status for other Pacific salmon species throughout Puget Sound. However, it is likely that natural production coho and steelhead stocks, at least, are currently at abundances well below historic levels, no matter what their SASSI status is.

It should also be noted that the majority of returning adult Chinook, coho, and steelhead in Puget Sound today are artificially produced at hatcheries, mainly to provide some fishing opportunity in the face of declining natural production. Although fishery managers undertake extensive monitoring and research to distinguish hatchery production from natural production, some fraction of the salmon identified as natural production are in fact derived from hatcheries and wouldn't be there if the hatcheries weren't producing fish. Thus, it is likely that the assessments of the current status of these species err on the

[5] Sockeye salmon require lake rearing habitat but do not normally require significant stream rearing habitat. However, there are some sockeye in Puget Sound rivers that are not apparently associated with lakes. See Groot and Margolis 1991.
[6] SASSI, p. 28
[7] The use of the EDT analysis to estimate historic production and recovery goals, and to compare these with current production for Puget Sound Chinook salmon, is documented in a report from the Puget Sound Technical Recovery Team: Rawson, K., K. P. Currens, R. Fuerstenberg, W. H. Graeber, M. H. Ruckelshaus, N. J. Sands, J. B. Scott *in prep.* Combining demographic and habitat-based approaches to triangulate on viability criteria for Puget Sound Chinook salmon populations, December 16, 2004.

optimistic side, and, the actual condition of natural production is worse than these assessments suggest. Also, the SASSI analysis was based on conditions more than 16 years ago in 1992. If state and tribal biologists repeated the SASSI classifications today, the statistics, at least for Chinook, coho, and steelhead, would likely indicate a more degraded resource.

2. Causes of the decline in status

Scientists and planners working on salmon recovery usually group the human-caused factors causing natural production salmon stocks to be in a degraded state into three areas: harvest, hatcheries, and habitat[8]. Other factors, such as ocean conditions, also affect the status of salmon stocks. I will address each of these in turn and then discuss how, in combination, they result in the current degraded status we see for many stocks.

Harvest

The state's and tribes' current approach to salmon harvest management is covered in detail in a later section. In general, harvest controls are implemented to assure that sufficient fish pass through to spawning areas so that the runs will continue to survive at a high enough level to provide future harvest. Appropriate harvest numbers or rates[9] for natural production fish depend on the abundance of the return in a given year and the expected productivity[10] of the fish allowed to spawn.

Salmon management biologists usually predict both abundance and productivity using statistical relationships necessarily developed from data collected for some number of years extending into the past. Error in forecasts is introduced due to the intrinsic variability of salmon populations and variability caused by not taking into account all of the factors that affect abundance and productivity. Besides variability, a bias, or a tendency to forecast too high or too low, can occur if the basic production regime has changed since the time the data underlying the statistical relationships underlying the forecasts were collected. This situation could occur if the amount or quality of habitat has changed, and is especially prevalent for the analyses underlying the harvest management guidelines (minimum escapement numbers or maximum harvest rates) because those analyses are usually only completed infrequently and thus are based on older data.

In addition to errors and uncertainty in forecasting abundance and productivity, there are errors in actually implementing a harvest management plan, i.e. harvesting a particular number or fraction of fish from a particular stock. These errors are mainly caused by uncertainty of stock origin in a particular fishery (most salmon fisheries harvest a mixture of several to many stocks) and uncertainty in the prediction of the number of fish that will be harvested (or otherwise killed such as by being caught and released) in response to a particular fishing regulation.

[8] Sometimes these are called "the 4 H's" with hydroelectric facilities added as fourth area. For Puget Sound work, however, the effects of hydroelectric dams are usually considered as part of "habitat".
[9] i.e. the fraction of the population that may be harvested
[10] i.e. number of fish in a future generation produced per spawning adult in this generation

Despite the opportunity for error at many points, salmon harvest management has generally been successful in the Case Area for at least the past couple of decades. Managers track many fisheries closely as they occur, use information from the fishery to update estimates of abundance, use sophisticated techniques to assess the stock composition in fisheries, adjust openings by time and area, and change fishing plans during the season in response to real time information. Recently, when faced with uncertainty, managers have started to use risk-averse, precautionary approaches to setting fishing plans, especially when they lack the ability to adjust a fishery during the fishing season for some reason.

As a result of the above, natural escapement numbers for many stocks in Puget Sound have been higher in recent years than the several decades before that. For example, the year 2001 saw the highest Chinook salmon spawning escapement for the Snohomish River since the beginning of the database in 1965, and 2008 saw the second highest level (Fig. 1). The 4-year moving average Snohomish Chinook escapement has been consistently above 6,000 fish since 2001 and below that level in all but one year from 1965 to 2000 (Fig. 1). There is a similar pattern for Chinook escapement in the Skagit and other Puget Sound rivers.

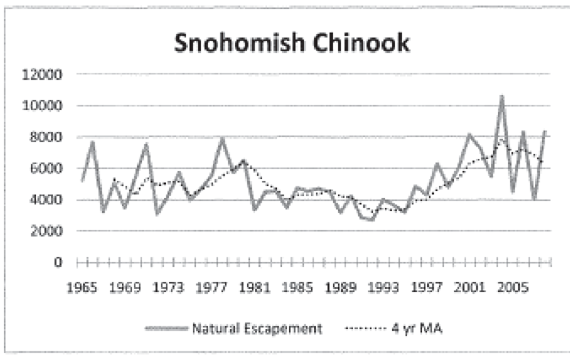

Figure 1. Snohomish chinook salmon escapement, 1965 - 2008. Annual observed values and 4-year moving averages (MA) are shown. Data from WDFW as reviewed and agreed to by the tribes.

Similarly, recent years have seen the highest escapements for coho (Fig. 2) in the Snohomish and chum (Fig. 3).

The increases in escapement for Chinook, coho, and chum since the late 1990s can all be attributed to decreasing harvest rates (for example, Fig. 2). However, there has been no corresponding increase in production that resulted from the higher escapements for any species, as shown, for example, by the failure of these runs to continue to grow, and in fact exhibit some decline in recent years' escapement. From this and other lines of evidence[11] I conclude that overharvest is not a current factor limiting the production of salmon in most Puget Sound rivers.

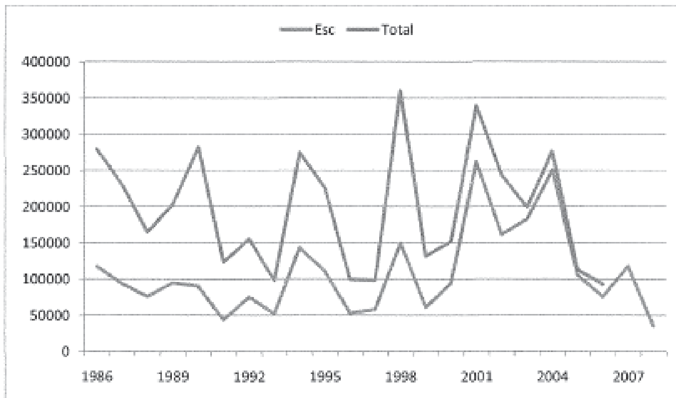

Figure 2. Graph of natural spawning escapement (Esc, lower line) and total run size (Total, upper line) for Snohomish coho, 1986-2006. The difference between the lines is harvest, which has greatly decreased over the period. The upturn in escapement is not associated with an increasing run size, suggesting that the escapement increase was due to the harvest reduction. SOURCE: My analysis of run size using exploitation rates from post-season "backwards FRAM" model runs computed by Larrie Lavoy of WDFW.

Hatcheries

Hatcheries have been used for more than 100 years in Puget Sound. As habitat was lost blocked, or irrevocably modified, agencies continued to build enhancement facilities with the thought that they could make up for declining natural production of salmon. Today they are ubiquitous, with state, tribal, and federal hatcheries operating in every major watershed (Fig. 4).

The theory behind salmon hatcheries is that, by removing a portion of the production from the dangers of part of the natural salmon life cycle, the overall productivity can be increased, thereby creating an opportunity for harvest that would not be present using natural production alone. The portions of the natural life cycle avoided in the hatchery life cycle are spawning, incubation, and early rearing. In some programs, fish are held and fed for up to a

[11] For example Sharma and Hilborn. *Can J Fish Aquat Sci* 58:1453-1463 (2001) analyzed data for coho salmon in 14 western Washington streams and concluded that "… the streams appear not to be spawner limited."

Habitat

It is almost universally agreed among salmon biologists that the principal factor contributing to the decline of salmon in the Case Area is loss of habitat required at several key life stages, for example, spawning and rearing, and degradation of the quality of remaining habitat that has not been fully lost.

Ocean Conditions

Survival of salmon from the point of migration from the estuary to the ocean to return to the river of origin is subject to fluctuating survival rates. Whereas some of the relationships between human activities and salmon survival in freshwater habitats are well understood, managers usually treat survival in the ocean as a "black box" that cannot be altered by our actions. Marine survival patterns are characterized by both interannual fluctuations and regime shifts. The latter represent fundamental changes in average survivals lasting 10 -20 years and giving rise to periods of "low", "moderate", or "high" ocean survival. The challenge for scientists trying to understand the causes of variability in salmon abundance is to control for marine survival fluctuations when looking for relationships with other factors.

The relationship between marine survival and freshwater survival can be illustrated in a conceptual model from an article by Peter Lawson, now with NOAA Fisheries (Fig. 5). In the face of both fluctuating ocean survival and degrading or shrinking freshwater habitat, a salmon abundance graph will show a pattern of fluctuating decline. As an example, using one of the longest available datasets for Puget Sound salmon, the terminal run of Skagit River Chinook appears to follow this pattern very closely (Fig. 6). The year-to-year variations reflect oscillating drivers, such as marine survival, annual climate variation, and the like. But, the overall trend for the 50-year period is downward, which can only be due to the effect of continually worsening freshwater habitat conditions. This pattern of fluctuating decline is seen in time series graphs of many Case Area salmon run sizes and catches.

A recent real world example of the conceptual model in Fig. 5 is the collapse of the Sacramento River fall Chinook stock and subsequent closure of the entire salmon fishery in California and southern Oregon. Experts reviewing the causes of this decline cite poor ocean conditions as the proximate cause of the production failure[14]. However, they point out that habitat loss and degradation has greatly weakened the resilience of Sacramento River fall Chinook such that the effects of poor ocean survival are exacerbated. They state that the ultimate cause that turned a production decline into a collapse was the loss of habitat quantity, quality, and diversity, and reliance on a small number of hatchery programs. Poor ocean conditions can cause poor survival, but loss of freshwater habitat worsens the effect of this on the resource.

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[14] Lindley, S T and 25 coauthors (2009) "What caused the Sacramento River fall chinook collapse?" Pre-publication report to the Pacific Fishery Management Council, March 18, 2009. http://www.pcouncil.org/bb/2009/0409/H2b_WGR_0409.pdf

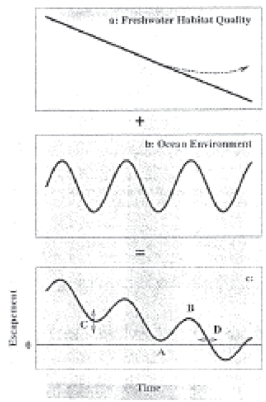

Figure 5. Graph of the relationship between freshwater production trends and marine survival fluctuations. SOURCE: *Fisheries* magazine[15].

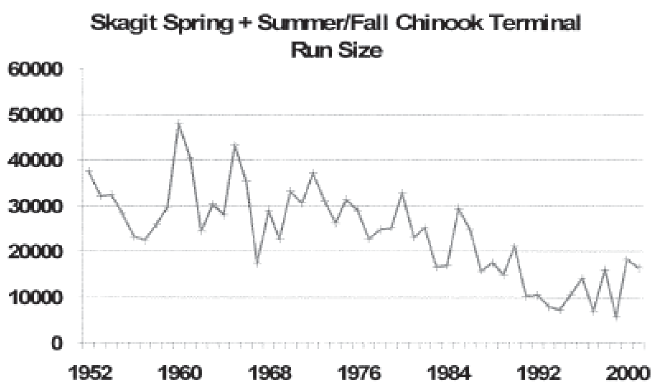

Figure 6. Skagit River terminal area chinook run size, 1952- 2002. SOURCE: Skagit Chinook recovery plan.

[15] Copied from Lawson, P. (1993) Cycles in ocean productivity, trends in habitat quality, and the restoration of salmon runs in Oregon. *Fisheries,* Bethesda, MD

3. Current state of the salmon fishery

Current Harvest Patterns

In the Boldt Case area salmon harvest has shown a general pattern of decline for the last 30 years, at least. Tribal harvest deviated from this pattern for awhile, after the final decision in *U S v Washington* when tribal fleets expanded after the tribes were no longer prevented from exercising their rights to harvest 50% of the harvestable surplus from runs passing through their usual and accustomed fishing areas. However, since the mid-1980s, both tribal and non-tribal harvest in the Case Area has shown a fluctuating downward trend (Fig. 7).

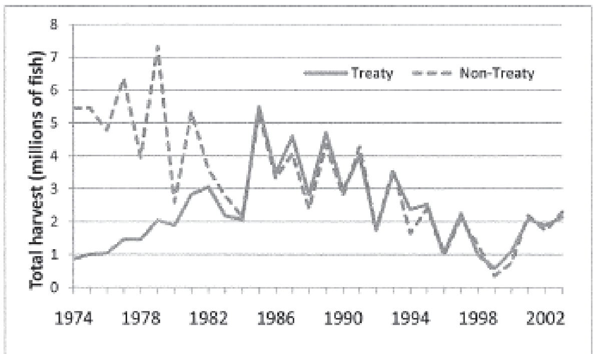

Figure 7. Total harvest of salmon and steelhead, all species, in the Case Area, 1974 - 2003. SOURCE: Harvest information provided by Keith Lutz[16].

Like salmon runs, salmon harvest is variable and affected by many factors. Tribal harvest numbers are determined by run sizes, fleet effectiveness, salmon prices, alternative economic opportunities, harvest of Case Area runs north of the US/Canada border, and conservation constraints on fisheries targeting abundant species in order to protect less abundant species harvested coincidentally. In my opinion, the decline in all harvest since at least the mid-1970s, and the decline in tribal salmon harvest since the mid-1980s is due to a general overall decline in salmon abundance and diminished opportunities on the ability to harvest abundant stocks because of increasing requirements to conserve weak stocks. Although many factors affect salmon abundance and harvest opportunity from year to year, the overall downward trend can only be attributed to loss of habitat quantity and quality.

Although tribal harvest opportunities continue to be available, these are increasingly dependent on strict controls as to the time, places, and manner of fishing, as well as on the artificial production of fish at salmon hatcheries. For example, the Tulalip Tribes harvest of

[16] Declaration of K. Lutz April 2009.

Chinook salmon has shown a slight decline over the past 30 years, but a major shift or the entire fishery to a small terminal area where hatchery fish can be targeted (Fig. 8). A similar shift is evident for coho (Fig. 9). Thus, due to chronic conservation concerns and lowered abundance of natural origin stocks, much of the Tulalip usual and accustomed fishing area is closed to salmon harvest at all times or opportunities are greatly diminished. Much tribal harvest now depends on hatchery fish produced at the tribes' own on-reservation enhancement facility.

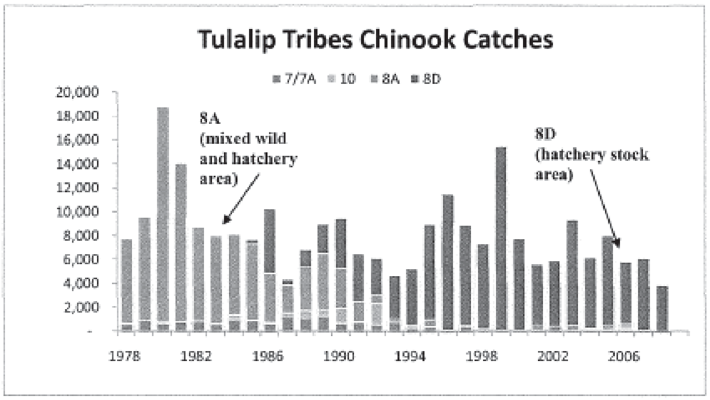

Figure 8. Tulalip Tribes chinook salmon harvest by area, 1978-2008. This shows the shift of nearly all harvest into Area 8D, a small terminal area where tribal members can harvest returning fish that were produced by the tribe at the Tulalip Hatchery. Nearly all of the tribe's usual and accustomed fishing area, extending 120 miles from the Canadian border to south of Seattle is permanently closed to chinook salmon harvest due to conservation concerns for natural chinook stocks. SOURCE: WDFW-tribal fish ticket database.

The reliance on hatchery production for maintaining harvest prevails for many of the tribes in the Case Area, especially in Puget Sound. For example, in terminal area net fisheries for coho, which are predominantly tribal, nearly 70% of the catch has on average been of fish that were produced in hatcheries (Table 3). Thus, these tribal fisheries depend heavily on hatchery production for coho salmon harvest opportunity.

While hatchery production can provide some harvest opportunity in the face of declining natural production, it comes at a cost in funds required to run the hatchery and potential negative impacts of hatchery fish on natural stocks. Hatchery fish are also less diverse than wild fish in their life history patterns and thus more susceptible to declines from natural catastrophes or changes in natural conditions. A current example is the recent severe decline of hatchery Chinook from the Sacramento River system and closure of the entire ocean fishery from Oregon south for at least two years. Increasing reliance on hatchery fish is most often associated with increased risk to fisheries. Only robust natural production can support sustainable salmon fisheries over the long term.

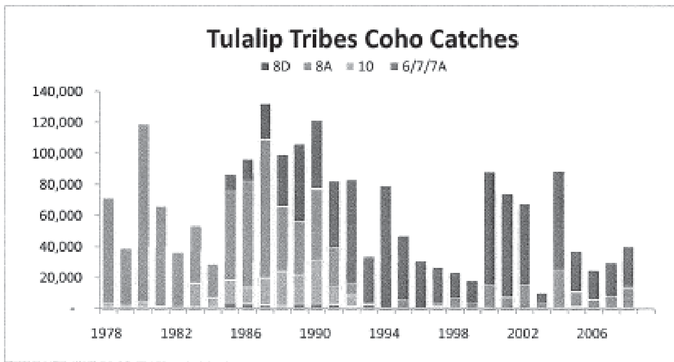

Figure 9. Tulalip tribes coho catches, 1978-2008, showing a shift to Area 8D similar to that shown for Chinook in Fig 4. SOURCE: WDFW-tribal fish ticket database.

Harvest Management in the Case Area

In the Case Area, salmon fisheries are jointly managed by the Case Area tribes and the State of Washington. These comanagers share responsibility for conservation of the resource and jointly determine how fishing opportunity will be apportioned between the non-tribal and tribal fishers so that each side will have a chance to harvest their share of the resource. The managers are then responsible for issuing and enforcing regulations that apply to their own users and that fit within the jointly developed management plans.

Salmon harvest management seems straightforward on the surface. A stock of salmon (for example, all of the fish of one species returning to a single river system) will have a requirement for a number of fish that must remain unharvested ("escapement goal") and pass through to the natural spawning areas in the river system. This number is often set as the population size that will allow for maximum sustainable harvest as determined either by analysis of observed escapement and return data from the recent past or from an analysis of current habitat quantity and quality. Fish returning in excess of this escapement goal are deemed harvestable, and the harvestable fish are allocated 50% to tribal fisheries and 50% to non-tribal fisheries.

Due to several factors, this simple model of salmon harvest management rarely applies in the real world. One complication is that the model does not work if there are fewer fish returning than are required for the escapement goal. Three factors often lead to this situation 1) low production due to degraded freshwater habitat, 2) poor survival in estuary and ocean waters, and 3) interceptions of fish north of the southern United States – Canada border.

When fewer fish than required for the escapement goal return, one might assume that there would be no harvest on that stock. However, the second complication to the simple harvest model comes into play here, namely the mixed-stock problem. Nearly all salmon fisheries are comprised of mixtures of stocks and species. Only rarely is a single species harvested, and even more rarely is all of the catch of one species from a single stock. In terminal areas, in rivers or near their mouths, or near hatchery release facilities, salmon harvests are predominantly of a single stock, but nearly always, there is some mixture of stocks in every fishery, and every stock is found to some degree in many fisheries. Thus, to realize a zero harvest on even just a few stocks might mean complete closure of much of the entire west coast to salmon fishing. Therefore, some low level of harvest is allowed on weak stocks, and fisheries are "shaped" through time, area, and gear restrictions to maintain low harvest rates on stocks of conservation concern while allowing more harvest on stronger stocks. To address the complexity of the mixture of stocks and fisheries, the comanagers use a computer model in their annual fishery planning discussions.

The FRAM Model for coho and Chinook

Salmon fisheries occur all along the west coast, with different stock mixtures for each combination of gear type, fishery location, and time of year. The comanagers use the Fishery Regulation Assessment Model (FRAM) to predict the cumulative impacts of annual fishing plans on west coast Chinook and coho stocks[17]. The coho FRAM includes 123 stock groups, representing nearly all west coast coho production. The Chinook FRAM includes 33 stock groups, representing most Chinook salmon production spawning in rivers from north-central Oregon northward to southern British Columbia. There are 73 fisheries in the Chinook FRAM and 198 fisheries in the coho FRAM. Most "stocks" in both models represent aggregations of actual stocks or populations and most "fisheries" in both models represent aggregations of actual fisheries (a particular gear type fishing in a particular area at a particular time period). The coho model divides the year into five segments[18] ("time steps"), and the chinook model into four segments[19], again representing an aggregation of what might be more accurately portrayed at a finer time resolution. So, the complexity of the model may be represented by the product (time steps) x (stocks) x (fisheries). But this is only a fraction of the complexity of the actual fishery.

The FRAM model uses abundance predictions for all of the model stocks as one key annual input. These are completed by the comanagers' biologists in December and January of each year, usually using statistically-derived relationships between the number of fish returning and prior spawning escapement, prior juvenile outmigration, and environmental variables. Where the numbers of juvenile outmigrants can be estimated with some degree of accuracy, as with in-river smolt traps for Chinook and coho or with beach seining for pink and chum fry, this often a precise predictor of subsequent adult returns for naturally-produced fish. If juvenile outmigrants cannot be directly estimated, then surrogate variables, such as the number of fish in the spawning escapement (directly related to the potential number of juvenile outmigrants produced) , quantity of streamflow in the summer low-flow period (directly related to the amount of freshwater rearing habitat), and the effect of high water

[17] See Model Evaluation Workgroup. 2007. "Fishery Regulation Assessment Model: An overview for coho and Chinook". Pacific Fishery Management Council, Portland, OR, and supporting documents cited therein.
[18] Jan-Jun, Jul, Aug, Sep, Oct-Dec
[19] (prior year) Oct-Apr, May-Jun, Jul-Sep, Oct-Apr (following year)

THE HONORABLE RICARDO S. MARTINEZ

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT SEATTLE

UNITED STATES OF AMERICA, ***et al.*****,** Plaintiff, vs. **STATE OF WASHINGTON,** ***et al.*****,** Defendant.	**No. C70-9213** **Subproceeding 01-1** **DECLARATION OF TYSON WALDO**

I, TYSON WALDO, declare as follows:

I am over the age of eighteen, a United States citizen, and am competent to testify as to the matters set forth herein. I make this declaration on the basis of my personal knowledge, skill, experience, training, education and review of the State's culvert data, provided to the Tribes in this case. This declaration is made by me for the purpose of explaining how I prepared the maps and tables identified as Plaintiff Intervenor Tribes Proposed Exhibits.

Law Offices of Lauren P. Rasmussen
1904 Third Avenue
Securities Bldg., Suite 1030
Seattle, WA 98101-1170
206-623-0900

'Habitat.dbf' have already been adjusted for habitat quality and the annual 60-day low flow period.

37.3 In January of 2009, the State provided a WDFW FPDSI| Habitat.dbf file containing habitat survey data from 1339 sites. Of those 1339 sites, 806 sites have at least some measure of stream length habitat upstream. Of those 1339 sites, 460 sites have at least some measure of "Spawning Habitat" upstream, and 507 sites have at least some measure of "Rearing Habitat" upstream.

37.4 I queried the FPDSI| CULVERT.dbf and FPDSI|PI.dbf to select sites that are state-owned and potentially blocking anadromous fish passage. This resulted in 1155 sites. For those 1155 sites, there are FPDSI| Habitat.dbf records for 1068 sites. From those 1068 sites, at least 634 sites have some measure of recorded habitat gain. Specifically 634 sites have a measure of habitat length, 411 sites have a measure of spawning habitat area, and 458 sites have a measure of rearing habitat area. Of the 634 sites, 147 are multiple upstream barriers and are removed from the potential lineal gain estimation. Of the 411 sites, 117 are multiple upstream barriers and are removed from the potential spawning habitat gain estimation. Of the 458 sites, 134 are multiple upstream barriers and are removed from the potential rearing habitat gain estimation. **Upstream of the remaining 487 sites with a measure of lineal gain, there are potentially705.79 miles of upstream habitat. Upstream of the remaining 294 sites with a spawning habitat measure, there is potentially 758,550 square meters of spawning area, and upstream of the remaining 324 sites of with a rearing habitat measure, there is potentially 3,702,693 square meters of rearing area.** The results are found in Proposed All Tribes, "Table 1. Estimate of anadromous

Law Offices of Lauren P. Rasmussen
1904 Third Avenue
Securities Bldg., Suite 1030
Seattle, WA 98101-1170
206-623-0900

salmon habitat upstream of DNR and DOT barrier culverts."

38. **WDNR Culverts.**

38.1 The WDNR datasets , Barriers.mdb| Culverts GIS dataset, the 'PI-2 21-all fish barrier costs 7-03.xls', the DNR_Update of Culverts for 1st & 2nd Set.xls and DNR's-repaired barriers dec 2006.xls were provided to me by counsel on December 19, 2006. In January of 2009, I received the file 'DNR repaired barriers nov2008.xls' and the R0008653| culverts.shp file. In June of 2009, I received 'barrier1208.xls', a list of the 457 remaining DNR blocking culverts in the Case Area. The following assessment of WADNR barrier culverts in the case area is based on the list provided in the 'barriers1208.xls'file, the R0008653| culverts.shp file and on the 'PI-221-all fish barrier costs 7-03.xls' file.

38.2 I linked the'barriers1208.xls' to the R0008653| culverts.shp file. I queried on the [CLVT_ANAD_FLG] field to select WDNR culverts associated with anadromous habitat in the case area. I queried 230 of the 457 culverts with anadromous fish presence from the combination of these two DNR datasets. .

38.3 From the 230 blocking WDNR culverts I accounted for and filtered out multiple blockages upstream of a blockage as I had done for the state-owned culverts in the WDFW data. As with those culverts, had I not done so, my query would have resulted in multiple counts of the same upstream habitat. The final query resulted in 208 WDNR-owned culverts potentially blocking anadromous fish habitat.

38.4 To estimate potential upstream habitat and fish production, I linked the 208 sites to

Law Offices of Lauren P. Rasmussen
1904 Third Avenue
Securities Bldg., Suite 1030
Seattle, WA 98101-1170
206-623-0900

the 'PI-2 21-all fish barrier costs 7-03.xls' dataset. Of the 208 sites, 27 have no associated record in the 'PI-2 21 all fish barrier costs 7-03.xls' file. The 181 culverts that link from 'barriers1208.xls' to the 'PI-2 21 all fish barrier costs 7-03.xls' dataset are used for this assessment.

38.5 The WDNR data reports habitat length above a culvert in the [Upstream Hab. Gain (ft)] field in the 'PI-2 21-all fish barrier costs 7-03.xls' dataset. I converted the values in the field from feet to miles to summarize potentially blocked habitat length by WRIA in miles. The WDNR'PI-2 21-all fish barrier costs 7-03.xls' dataset does not report on spawning habitat, so no spawning habitat is summarized for the WDNR potential blockages.

38.6 The WDNR 'PI-2 21-all fish barrier costs 7-03.xls' dataset record "rearing" habitat in the [Hab. Gain in m2] field. Unlike the WDFW data, the WDNR data also does not take into account habitat quality. I adjusted **the [Hab.Gain in m2]** field in the DNR data for habitat quality so that it could be used to calculate upstream habitat or adult anadromous salmonid production impacts using the WDFW methodology. To factor in habitat quality, I assumed a condition of 'Fair' for potentially blocked habitat above WDNR culverts. I assumed 'Fair' because in the Culvert Assessment Manual 'Fair' is the default habitat quality weighting (WDFW 2000). The WDFW methodology assigns a weight of 0.67 to a 'fair' condition. I therefore multiplied all the records in the [Hab. Gain in m2] field by 0.67. I did not adjust the WDNR habitat areas to reflect the annual 60-day low flow period because the data needed to calculate the annual 60-day low flow period for the WDNR culverts was not available. Additionally, WDNR calculates [Hab. Gain in m2] as (2+ ([Width_ Ordinary High Water Mark]*[Upstream Hab. Gain_length]))/2, so it is

Law Offices of Lauren P. Rasmussen
1904 Third Avenue
Securities Bldg., Suite 1030
Seattle, WA 98101-1170
206-623-0900

already a wetted area fraction of total habitat area.

38.7 From these data, **I summarized that there is potentially 195.75 miles and 364,713.56 square meters of anadromous salmon habitat upstream of 181 WADNR barrier culverts..** The results are found in Proposed All Tribes' Exhibits "Table 1. Estimate of anadromous salmonhabitat upstream of DNR and DOT barrier culverts."

Task 3: Potentially blocked habitat above state-owned culverts.

- 18_Table 1. Estimate of anadromous salmon habitat upstream of DNR and DOT barrier culverts.pdf.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed this 13th day of October, 2009, at Bellingham, Washington.

____

Tyson Waldo

Law Offices of Lauren P. Rasmussen
1904 Third Avenue
Securities Bldg., Suite 1030
Seattle, WA 98101-1170
206-623-0900

Table 1, Estimate of habitat upstream of DNR and DOT culverts .

WRIA	OWNER	Lngth_Mi	Spawn_M2	Rear_M2
01	DFW/DOT	56.05	41992.00	235956.00
03	DFW/DOT	44.64	32450.00	186233.00
04	DFW/DOT	4.02	1935.00	16227.00
05	DFW/DOT	30.01	41084.00	143013.00
06	DFW/DOT	4.49	986.00	110788.00
07	DFW/DOT	63.15	36690.00	290702.00
08	DFW/DOT	80.16	116239.00	775813.00
09	DFW/DOT	1.61	142.00	12685.00
10	DFW/DOT	21.04	10657.00	86660.00
11	DFW/DOT	22.13	11206.00	117525.00
13	DFW/DOT	3.12	1624.00	18204.00
14	DFW/DOT	20.62	18504.00	67542.00
15	DFW/DOT	80.11	118180.00	479987.00
16	DFW/DOT	8.18	10258.00	36310.00
17	DFW/DOT	40.92	28208.00	182221.00
18	DFW/DOT	36.58	40677.00	89587.00
19	DFW/DOT	42.17	46695.00	95064.00
20	DFW/DOT	31.69	76323.00	113482.00
21	DFW/DOT	20.19	40030.00	64319.00
22	DFW/DOT	66.64	64664.00	509269.00
23	DFW/DOT	26.27	19806.00	71106.00
	TOTAL	705.79	758550.00	3702693.00
01	DNR	2.26	0.00	7075.48
03	DNR	12.76	0.00	31038.06
04	DNR	2.43	0.00	5539.26
05	DNR	9.16	0.00	22017.40
07	DNR	24.80	0.00	45631.98
08	DNR	0.26	0.00	273.09
09	DNR	0.96	0.00	1651.36
11	DNR	0.00	0.00	0.00
14	DNR	0.85	0.00	1668.98
15	DNR	4.23	0.00	7451.00
16	DNR	0.00	0.00	0.00
17	DNR	12.81	0.00	15158.91
18	DNR	0.00	0.00	0.00
19	DNR	6.62	0.00	12257.10
20	DNR	32.20	0.00	57875.50
21	DNR	23.39	0.00	42968.32
22	DNR	15.10	0.00	54396.15
23	DNR	47.93	0.00	59710.94
	TOTAL	195.74	0.00	364713.56
	COMBINED	901.53	758550.00	4067406.56

WASHINGTON DEPARTMENT OF FISHERIES
WASHINGTON DEPARTMENT OF TRANSPORTATION

FISH PASSAGE PROGRAM
PROGRESS PERFORMANCE REPORT
FOR THE BIENNIUM 1991-1993

PREPARED FOR THE
WASHINGTON STATE LEGISLATURE

December 1992

Interagency Agreement FY 92.30(1)GC 9392

SUBMITTED BY

Tom Burns
Greg Johnson
Tanja Lehr

WASHINGTON DEPARTMENT OF FISHERIES
HABITAT MANAGEMENT DIVISION
SALMON HABITAT ENHANCEMENT AND REHABILITATION UNIT
AND TECHNICAL RESOURCE SECTION

EXECUTIVE SUMMARY

Wild salmon[1] have important cultural, ecological, and economic value to the people of the state of Washington. One threat to this resource is human-made migration barriers created by improperly installed or undersized culverts commonly installed to allow road crossings over salmon-bearing streams. Many of these culvert barriers exclude juvenile and adult salmon from valuable habitat, resulting in a decrease in salmon production and harvest opportunity. The 1991 Washington State Legislature recognized that culvert barriers threaten sustained salmon populations and the resulting harvest opportunity in this state. Hence, the Legislature in 1991 directed the departments of Fisheries (WDF) and Transportation (DOT) to cooperate in the inventory and correction of salmon migration barriers at state highway road culverts during the 1991-1993 biennium. This report documents 1991-93 biennium activities to date and planned activities for biennium 1993-95.

For biennium 1991-93, WDF and DOT participated in fish barrier resolution through two Memoranda of Understanding (MOU). The first concerns WDF, DOT, and Department of Wildlife (WDW) compliance with the Hydraulic Code. The second is an interagency agreement by WDF and DOT to conduct a fish passage inventory of state highway culverts and to correct six known barriers. This was subsequently modified to correct five barriers and to complete preliminary planning of two others. The optimistic goal of fish barrier resolution at all state road culverts is 20 years.

WDF and DOT also participated in interagency training and education of biologists, environmentalists and engineers. This included a full day training on salmon life history and fish passage problems at culverts.

Consistent with the interagency agreements, WDF has initiated an ongoing inventory of state highway culverts. To date WDF has inspected 726 state highway culverts in five of the six DOT districts. Of those inventoried 264 (36.4%) were determined to interfere with fish passage some percentage of the time, of which 126 (17.4%) were total blockages (Figure 1). Many more barriers are expected to be found with further inspections. Also, upstream habitat evaluation must still occur for most of the blockages. Complete correction of all existing state highway culvert barriers will take decades of planning, inventory, evaluation, and construction. This effort will clearly require administrative support for interagency cooperation.

[1] The orientation of this report is toward salmon, but many comments are applicable to wild steelhead as well.

BACKGROUND

The five species of salmon which evolved in the Pacific Northwest are strongly anadromous, meaning they reproduce in fresh water and mature in the ocean. All salmon have in common a requirement to use clean, stable, well oxygenated gravel habitats for spawning, often in the terminal headwaters of freshwater streams and rivers. Access to these habitats cannot be blocked without endangering locally adapted salmon. However, through the activities of humans and rare milestones in nature, salmon are sometimes blocked from prime spawning and rearing areas. A significant threat to the complete life cycle of any distinct group of salmon is road construction and the installation of road culverts, which often pose migration barriers. Increasing numbers of roads and culverts are a common product of a growing human population in Washington. Culverts often pose immediate or eventual migration barriers to salmon due to design which does not ever allow fish passage or design that does not account for the dynamic nature of flowing water, therefore resulting in a delayed barrier. These dynamics are caused by changes in hydrology of streams due to road-associated activities such as paving, fires, or clear cutting.

A common misconception is that barriers affect only adult salmon. Current life history research indicates movements of juveniles upstream into springs, ponds, marshes, and seasonal streams. Many of these areas are blocked to juvenile salmonids by culverts. Juvenile salmon are less powerful swimmers than adults and their ability to migrate through culverts is not clearly understood, which warrants further investigation.

Salmon provide this state valuable sport and commercial fisheries, but to do so they must migrate unrestricted to native streams in sufficient numbers to reproduce abundant, vigorous offspring. In Puget Sound and Strait of Juan De Fuca tributaries, an incomplete WDF inventory shows that 420 human-caused fish migration blocks of various kinds exist (excluding hydropower projects). At least 350 miles of spawning and rearing habitat are subsequently excluded from production in those areas. Human-caused blockages to adult salmon spawning and rearing habitat continues to be one of the most common and avoidable ways fish production is lost in the Pacific Northwest.

FISH PASSAGE INVENTORY

Process

The WDF Fish Passage Inventory can be divided into four phases: 1) a search on state highways for stream culverts which prevent or restrict the upstream migration of salmon, 2) further investigation of stream sections where these culverts are located to determine salmon presence in the streams and fish access up to the culvert, 3) measurement of habitat quality and quantity above the barrier culverts, and 4) engineering evaluation of improvements needed for fish passage. Data management and development of project lists occurs in conjunction with all four phases.

Search

Washington is divided into six Districts by DOT. WDF uses those designations for the culvert inventory schedule. District boundaries generally follow county lines, though some are different. Counties included in each district are: District 1- Island, King, San Juan, Skagit, Snohomish and Whatcom; District 2- Chelan, Douglas, Ferry, Grant and Okanogan; District 3- Clallam, Grays Harbor, Jefferson, Kitsap, Mason, Pierce and Thurston; District 4- Clark, Cowlitz, Klickitat, Lewis, Pacific, Skamania and Wahkiakum; District 5- Asotin, Benton, Columbia, Franklin, Garfield, Kittitas, Walla Walla and Yakima; and District 6- Adams, Lincoln, Pend Oreille, Spokane, Stevens and Whitman (Figure 2).

The order of District inspection was determined so the evaluation of culverts and streams would coincide with adult salmon presence to help verify fish access to culverts. For example, District 3, which includes the Olympic Peninsula, is being inventoried during November when coho salmon runs peak. Streams in Districts 5 and 2, where spring and summer chinook are present, were evaluated during spring and summer of 1992. For this reason, District 1 was inventoried first, followed by Districts 5,2,3,4 and 6. Generally, three months are allotted to the inventory of culverts in each district.

The search for barrier culverts is conducted by driving each state highway and stopping at each stream crossing. The streams are identified using the WDF Catalog of Washington Streams and Salmon Utilization and a DeLorme Atlas of Washington State. The highway mile of the culvert is noted, using the vehicle odometer and highway mile posts. Those streams not appearing on either reference are identified by highway mile. Bridges are assumed passable and not evaluated.

Washington Department of Wildlife Pacific Northwest Environmental Database, and any other available information. Depending on the amount of information obtained from these sources, WDF may also identify species by electroshocking the stream, using a portable backpack electrofisher.

Downstream barriers are located by surveying the stream from the culvert to the mouth. All barriers to salmon are noted. A culvert with natural barriers downstream may be given no further consideration as a project of immediate importance. If a resolvable human-caused barrier is located below a DOT fish passage problem the project still is given a priority.

Habitat Measurement

The amount of salmon habitat blocked by each impassable culvert is measured next. Habitat evaluation begins at the barrier, and proceeds upstream. The string from a belt chain is tied to the culvert, and surveyors (usually two people) walk upstream. The belt chain measures the distance walked, in meters.

In addition to measuring the length of usable stream above the culvert, surveys divide the stream into pools, riffles, and rapids. Total surface area is also calculated. For creeks less than one mile long, a 30-meter sample is taken after every 0.1 mile walked. In streams more than one mile long, 60 meter lengths are sampled every 0.2 miles. In each sample area, the streambed composition is estimated (percentages each of boulder, rubble, gravel and sand present), and the stream gradient is measured with a clinometer (see Appendix C for physical survey format).

Measurement continues until a natural barrier is reached, or the stream is too small or steep for salmon use. If a human-made barrier is reached, the end of immediate habitat is noted, and the survey is continued. The area above this barrier is termed potential habitat. If a natural barrier is reached, or gradients exceed 7%, the survey is ended.

The information collected in the habitat survey is entered in a spreadsheet program which uses the riffle, pool and rapid measurements to compute the total spawning and rearing habitat areas (in square meters) for both the immediate and potential habitat areas. Pool areas are considered rearing habitat, and riffle areas are considered spawning habitat. Rapids are considered unusable by salmon, except as transport waters. Riffle:pool:rapid ratios are also computed.

The Priority Index

Characterizing and prioritizing corrections to fish passage barriers is complex in terms of cost, habitat gain, and multi-species utilization. Early in the inventory planning stages, a numeric modeling approach to prioritizing projects was developed, which recommended correction of those passage problems which were most feasible first. To do this, the numerous factors which affect a project's feasibility are used, including: passage improvement, production potential of the blocked stream, size of blocked stream habitat, affected fisheries, affected stock status listed in the Washington State Salmon and Steelhead Stock Inventory (SASSI)[1], and project cost. The result is a numeric indicator giving each project's priority. LOG .25 (the quadratic root) of the project variables product is calculated to provide a more manageable number for the priority index. Supporting data for the fish passage prioritization are attached in Appendix C. The priority index (PI) for each barrier is calculated as follows:

$$PI = \sum_{all\ stocks} [(BPH) \times FDC]^{1/4}$$

Where:

PI = Priority index (i.e., relative project benefit considering cost)

B = Proportion of passage improvement (i.e.,proportion of run expected to gain access by the project)

P = Annual adult equivalent production potential per m^2 (this incorporates juvenile survival factors if juveniles, but not adults, utilize habitat, Appendix D).

H = Habitat gain in m^2

F = Fishery Impact modifier (Appendix E)
- 3 = a stock managed on a wild stock basis whose enhancement would have allowed a higher exploitation rate at least twice in the last eight years in mixed stock fisheries (where allocation units are mixed). (e.g. Skagit or Hood Canal coho)
- 2 = a stock managed on a wild stock basis whose enhancement would not have allowed a higher exploitation rate at least twice in the last eight years in mixed stock fisheries, but would typically have allowed a higher exploitation rate in terminal and/or extreme terminal fisheries (e.g. Snohomish or Stillaguamish chum).
- 1 = a stock not meeting the conditions for 2 or 3 (e.g. Nooksack coho).

D = Depleted Stock modifier
- 3 = a stock listed as critical in the SASSI report (e.g. Snake River spring/summer chinook or sockeye).

[1] Report is being finalized

2 = a stock listed as depressed or a stock of concern in the SASSI report (e.g. Nooksack coho)
1 = a stock not meeting the conditions for 2 or 3 (e.g. Samish chum)

C = Cost modifier (low, medium, high)
3 = incremental funds needed ≤$100K because of actual cost &/or constituency (monetary) support &/or funds that are already programmed for road improvement that do not have to be spent specifically on fish passage
2 = incremental funds needed >$100K and ≤$500K....
1 = incremental funds needed >$500K....

Activities and Costs by DOT District

Following is a summary of WDF work completed to date in each district. See Table 1 for expenditures by district.

District #1

Highway types in District 1 range from the urbanized I-5 corridor and freeways in King and Pierce counties, to rural mountain roads in the northern reaches of the district. Steep rural roads often have high road fills over stream crossings, making access and culvert evaluation physically difficult. High-speed urban roads are also difficult to evaluate, due to high volumes of traffic and the dangers of parking and working along narrow road shoulders. Also present are lowland tributaries which flow through wetlands and agricultural areas. All five species of Pacific salmon (chum, chinook, coho, pink and sockeye) are present in this district, although not all are necessarily represented in each stream. Streams impacted by barriers at state highways in this district are used by chum and coho; backwatered areas and small tributaries are important for the rearing of coho juveniles. Chinook salmon are also present in this district. Adult chinook generally utilize large tributaries, usually spanned by bridges. Sockeye salmon are found in Lake Washington and its tributaries, while pink salmon are widely distributed in the district.

Work in this district took place beginning in January of 1991, and ending in early April of 1992 (although work began in November, the time between November and mid-January was spent in training and methodology development). After preparation, inventory in District 1 began January 16th. March and April were spent investigating salmon presence and conducting downstream surveys, and measuring habitat above barrier culverts. Due to the three-month district limit, WDF was not able to completely evaluate all state routes in this District, nor were we able to survey the stream area above and below all of the impassable culverts found.

APPENDIX C

Supporting data for DOT inventory fish passage priority index.

COHO

Estimated smolt to adult survival for Washington streams = 10%. State of Washington Department of Fisheries Department of Natural Resources Progress Report No. 233 Riverine Pond Enhancement Project October 1982-December 1983. N. Phil Peterson, October, 1985 p. 33.

Estimated fingerling to smolt survival for Skagit River waters = 40%. Skagit River off channel trapping. Chris Detrick personal communication - 1992.

Estimated production per square meter of habitat for coho salmon smolts = .42/square yard or .5/square meter. Methodology for Determining Puget Sound Coho Escapement Goals, Escapement Estimates, Pre Season Run Size Prediction and In-season Run Assessment. Technical Report 28, Washington Department of Fisheries. 1977.

Based on this information the estimated adult production per square meter of total stream area in Washington streams is .05 adult coho per square meter of stream area.

SPRING CHINOOK

Marshall and Britton (1980) use coho production potential to apply to spring chinook - assumes that yearling spring chinook and yearling coho occupy their respective habitats at the same densities = .5/M square.

Mean smolt to adult survival (Lindsay and Jonasson - 1983) and Wahle et. al. (1981) estimate .4 to 3.2% smolt/adult survival, mean of this = 1.8% for spring chinook. White Salmon River Productivity Report Draft, November 1989, p. 19.

Spring/Summer chinook modifier = .009 adults/M square of total habitat.

FALL CHINOOK

IFIM Method - resulting value is factored by a smolt density value of .37 smolts/M square (Chapman - 1981), derived from research on the Big Qualicum River in British Columbia. Mean survival from smolt to adult = 1.5% (Walhe and Vreeland - 1978) White Salmon River Productivity Report - November, 1989. Draft. p. 22.

SOCKEYE

Foerster - 1968 estimates overall survival of Fraser and Columbia River Sockeye at 0.25% egg to adult. Further he estimates the sustained catch to escapement ratio at 4:1 for those regions. P. 68. Foerster further documented one fully utilized 360 square yard section of Williams Creek to be at 103 females and 109 males for a density of 3.5 square yards (2.9 square meters). At densities above this "new unspawned fish attempting to start a redd were attacked by other females."

Hence: for sockeye, one sockeye redd = 2.9 meters square of spawning habitat. Two spawning adults will produce 3,500 eggs x .25%. Overall survival = 8.75 adults per 2.9 meters square = 3 adults produced per meter square of spawning habitat (p. 122).

Foerster, R.E., The Sockeye Salmon, Oncorhynchus nerka. Fisheries Research Board of Canada, Ottowa 1968. Bulletin 162.

CHUM

Tom Burns, unpublished, calculated chum production by the following:

0.5 (female/meter square) X meters square of spawning habitat X 2,500 eggs/female X .10 egg to fry survival X .01 fry to adult survival.

PINK

Currently it is proposed this model uses chum feasibility for pinks.

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SUBMITTED BY
Ken Bates
Greg Johnson
Tanja Lehr
Jim Lenzi
Pat Powers

WASHINGTON DEPARTMENT OF FISH & WILDLIFE
HABITAT PROGRAM

Salmonid Screening, Habitat Enhancement,
and Restoration (SSHEAR)
Division

and

Engineering and Technical Services Division

Washington Department of FISH and WILDLIFE

Washington State Department of Transportation

EXECUTIVE SUMMARY

For many reasons, protection of salmon and trout and the critical habitat in which they live is essential in the Pacific Northwest. One serious problem to salmonid production in Washington is impassable road culverts. In numerous cases, miles of productive freshwater anadromous fish habitat have been blocked from anadromous fish by a single barrier road culvert. Correction of human-made barriers to fish migration is one of the most cost effective habitat restoration strategies available because habitat gains from a minimal amount of work are often large. Hence, fish access to habitat has become an important, timely issue and has been addressed by the Washington State Legislature during the bienniums 1991-1993 and 1993-1995. In addition, correction of human-made fish migration barriers is required by the following State Laws: RCW 75.20.060, entitled "Fishways required in dams, obstructions-penalties, remedies for failure"; RCW 75.20.061, "Director may modify inadequate fishways and fish guards"; RCW 77.16.210, entitled "Fishways to be provided and maintained"; and RCW 77.12.425, "Director may modify inadequate fishways and protective devices".

Documentation of efforts to inventory and correct fish passage problems at Washington State highway culverts is the topic of this report. It examines Washington Department of Transportation (WSDOT) and Washington Department of Fish and Wildlife (WDFW) activities pursuant to inventory and correction of fish passage barriers at state highway road culverts for the bienniums 1991-93 and 1993-95. It is an update to the Fish Passage Program Progress Performance Report for the Biennium 1991-1993, completed in December 1992. Many methodologies for this inventory were developed in 1991, discussed in the last report, and will be referred to in this document. In some cases revisions to the original methodology occurred this biennium and will be discussed in this report.

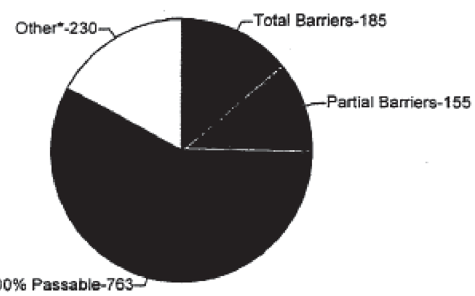
For the biennium 1993-95 WDFW and WSDOT continued with inventory and fish barrier resolution through interagency agreement (Appendices II-IV). The purpose of the agreement is to provide funding to continue with a fish passage inventory of state highway culverts and to correct six prioritized barriers for the biennium that have resulted from the inventory.

The WSDOT / WDFW strategy for inventory and correction of fish passage barriers is as follows:

- Reporting and documentation of state highway road culvert fish passage problems (inventory).
- Verification of fish passage up to barrier culverts, quantification and qualification of blocked habitat, and prioritization of barriers for correction based on cost benefit evaluation called priority indexing.
- Design and construction of fish passage facilities on high priority barriers (most cost effective) with dedicated barrier correction funding.
- Concurrently identify and correct fish migration barriers associated with safety and mobility road projects.

To date, WDFW has completed all of the road culvert inventory segment and has inspected a total of 1,333 culverts on state routes throughout all six WSDOT Districts. WDFW has identified 340 barrier culverts for further evaluation. WDFW has located a total of 185 total migration barrier culverts, and an additional 155 culverts having a partial blockage to salmonids.

Total no. of culverts inspected =1,333



*"Other" indicates culverts for which no passability estimates were made, due to problems such as no access up to the culvert, no anadromous habitat gain upstream of culvert, etc.

Surveys, habitat assessments, and downstream verification of fish passage up to identified barriers have been completed on 91 streams out of the total 340. A total potential rearing area of 318,000 square meters (m^2) is currently blocked by WSDOT culverts on these 91 streams; this is roughly enough wetted stream area to produce 29,000 adult salmon annually. Approximately 105 linear miles of spawning and rearing area are known to be blocked from salmonid production by barrier WSDOT culverts on the 91 surveyed streams. All physical surveys are planned for completion by July 1997.

Working together, WDFW and WSDOT have resolved ten barrier culvert problems since 1991, with planning underway for resolution of another six during the next biennium (1995-1997). To date, WSDOT fish passage projects accomplished include:

Tumwater Creek Fishway
Parish Creek Fishway
Fisher Creek Fishway
Green Creek Fishway
Unnamed Tributary to Skykomish Fishway
Chuckanut Creek Fishway
Evans Creek Fishway
Bagley Creek Fishway
South Fork Nemah River Fishway
Squalicum Creek Fishway.

Total habitat gained for these projects was 121,000 m^2, or roughly enough stream area to produce 14,600 adult salmon annually.

During the 1993-95 biennium, it was recognized that long-term planning between WSDOT and WDFW should include not only dedicated, independent funding projects, but communication between the two agencies to accomplish barrier correction in conjunction with planned road projects such as safety and mobility improvements regularly done by WSDOT. Given the number of barriers identified in the inventory, it would take over a century, with a much lower benefit to cost ratio to correct 340 barriers using only dedicated funding (correcting 3 barriers/year). The benefit/cost ratio increases as the number of culverts repaired per year increases. Using a method such as road project-associated culvert repairs, fixes would be done quickly and costs of mobilization would be greatly reduced since equipment would be on-site or in the vicinity for road construction. Road project-associated fish passage improvements would require long term commitment by the legislature and would be beneficial in correcting problems affecting many depressed salmonid stocks in need of immediate attention. In the future, this strategy could assist in avoidance of petitions under the Endangered Species Act. Working for correction through road improvement work, it was determined that over a century of fish passage work could be reduced to two or three decades. The end result would be a process incorporating accelerated correction for high priority barriers and organized, efficient correction of the remainder of barriers.

WDFW is continuing interagency education and training efforts with frequent interagency staff meetings, and by forwarding a quarterly information bulletin update summarizing activities and strategies to WSDOT. In addition, day-long workshops entitled "Fish Passage Design at Road Crossings" were conducted on June 2, 1992, November 23, 1993 and June 15, 1994. A repeat is planned for January 18, 1995, and WDFW is planning to publish articles related to fish passage and inventory of culverts for the WSDOT Maintenance Newsletter, beginning in January 1995.

Consistent with interagency agreements, WDFW has completed on-site culvert inspections within all six WSDOT Districts and is now working on habitat evaluations and fish use verifications at culverts thought to be blocking fish from usable habitat. These evaluations will be completed during the 1995-1997 biennium. Resolution of all culvert blockages will take decades of planning,surveying, design, and construction. This effort will clearly require administrative and legislative support.

BACKGROUND

It is recognized that salmon and trout are extremely important to the culture and economy of the Pacific Northwest, particularly in coastal communities, where the impacts of low salmon returns and fishing closures in 1994 have left port towns in financial crisis.

Similarly, it is recognized that wild, locally adapted salmon play an important role in a complex ecological food web that involves many types of birds and animals; some species listed as endangered, threatened, monitor, or candidate under the Endangered Species Act (ESA) depend to some degree on the distribution and abundance of salmon and trout.

Alarming declines in anadromous fish in Washington during the early 1990's have caused intensive concern among fish managers, commercial and sport fishing interests, environmentalists, Native Americans, and legislatures. Overharvest, hydropower development and habitat degradation, as well as oceanic events such as El Niño, are often referred to as causes. One habitat-related cause for weakening of salmon production which can be comparatively easily resolved is human-made barriers to fish migrations caused by improper placement of road culverts. Increasing numbers of roads and resulting culverts are a common product of a growing human population in Washington. Culverts often pose immediate or eventual migration barriers to salmon due to design which does not allow passage, or design that fails to consider the hydrology of watersheds, resulting in a delayed barrier. Changes in hydrology of streams can be natural or can result from watershed-related activities such as logging, road construction, paving, or fires. These factors can cause a passable culvert to become a barrier once streambed scour occurs below the culvert. In recognition of this, the Washington State Legislature directed the former Department of Fisheries (now the Department of Fish and Wildlife) and the Washington State Department of Transportation to cooperate in the inventory and correction of salmon and trout migration barriers at state highway road culverts in the 1991-1993 and 1993-1995 bienniums.

A common misconception is that only adult salmonids are affected by culvert barriers, as they return from the ocean to native rivers and streams to spawn. Recent life history studies on salmonids reveal that culverts can also limit juvenile production by blocking them from important rearing areas. Research indicates the upstream movement of young salmonids during the winter months into areas of low velocity such as ponds, swamps, and marshes, often referred to as off-channel habitat. Young salmonids cannot attain the swimming speeds of adults and are easily blocked from these areas by improperly placed culverts. It is also a common misconception that streams which dry in the summer have no value to salmonids; this is also not the case. Chum, pink, and sockeye salmon use these areas for spawning, and juvenile coho salmon or chinook salmon for rearing during high-flow months.

WDF / WDW / WSDOT Memorandum of Understanding (GC 9058)

On December 27, 1990, final signatures were obtained for the interagency Memorandum of Understanding (MOU) GC 9058 (Appendix III) among the Washington State Departments of Fisheries, Wildlife, and Transportation concerning compliance with the Hydraulic Code (RCW 75.20.100 and Chapter 220-110 WAC) (Appendix I). Its purpose was to provide a mutual understanding among the participating agencies of procedures and standards for the application and acquisition of Hydraulic Project Approvals (HPA). Within the agreement is the requirement that WSDOT apply for the HPA to WDW or WDF for all instream projects, and for WDF or WDW to provide a timely response so road projects can proceed.

The MOU defined key words that frequent negotiations concerning fish migration barriers: enhancement, emergency, fish passage barrier, hydraulic project, mitigation, and transportation project. This MOU requires annual meetings between agencies in advance of construction dates where plans for new road construction or maintenance and potential wildlife or fisheries impacts can be addressed. Other items addressed in this MOU are maintenance guidelines for dealing with emergencies, needed training, resolution or concerns, and MOU duration. Finally, this MOU includes an Appendix outlining fish passage guidelines to be administered at future road culvert construction or maintenance sites.

WDF / WSDOT State Interagency Agreement For Fish Passage Inventory and Barrier Removal (GC 9392)

In 1991, the Legislature directed WSDOT to correct six fish barriers during the 1991-93 biennium. To further facilitate this mandate and locate other fish passage problems at state highways in Washington, WDF and WSDOT entered into a specific State Interagency Agreement to perform a fish passage inventory statewide and work collectively in planning projects and developing agreements to remove fish barriers at WSDOT culverts (Appendix II). This agreement commenced December 6, 1991, and provided the initial funding for both the newly organized fish passage inventory section in WDF and the correction of fish passage problems. Amounts allocated for inventory and correction were $105,000 and $280,000, respectively, for the biennium.

WDFW / WSDOT Memorandum of Understanding Inventory and Barrier Removal

On June 24, 1993, WSDOT, and the former WDF entered into an agreement (WDF 810-000030) to proceed with work outlined in previous agreements GC 9058 and GC 9392 (Appendix IV). The agreement provides funding for statewide inventory of fish passage barriers on WSDOT rights-of-way and removal of barriers independent of highway construction projects. WSDOT agreed to provide funding in the maximum amount of $730,000 to correct barriers identified through the inventory process (refer to Table I for the Budget / Function summary for the WSDOT / WDFW Fish Passage Inventory). Further, it provided $380,000 to continue inventory activities, with funding by the 1993 legislature.

ROAD PROJECT AND BARRIER REMOVAL PLANNING

During the 1993-95 biennium, it was recognized that long-term planning between WSDOT and WDFW should include not only funding for dedicated, independent fish passage projects, but also

- close communication and coordination between the two agencies
- identification and correction of barriers in conjunction with road work, and
- long-term commitment by the legislature

This became apparent when it was estimated that it would take over 100 years to correct all barriers at state highway culverts with independent fish passage projects alone. Alternatively, a carefully designed blend of this effort with fish passage work on mobility and safety road projects could reduce this time span to roughly two to three decades. This improves cost efficiency because mobilization and some work efforts at the culvert sites would not have to be duplicated and because benefits of restored fish production would not be delayed nearly as long. In fact, it has been estimated that every dollar spent on fish passage work will return a minimum of four dollars in fish benefits, even when not considering nonconsumptive values. This is particularly important for those fish stocks that are depressed to the point of potential listing under the Endangered Species Act. Obviously, correction of a problem to avoid such listing would circumvent the large recovery costs.

These concepts have been embraced by the two agencies, as reflected in the sharing of information concerning anticipated road work and fish passage barriers. Corresponding budget request packages to implement this approach have been agreed to by the agencies and submitted for legislative approval. The end result will be a process incorporating accelerated correction for high-priority barriers and organized, efficient correction of the remainder of barriers.

Phase I - Search

The search for barrier culverts was conducted by driving each state highway and stopping at every stream crossing. Bridges were assumed passable and not evaluated. Streams were located and identified by name and/or WRIA # (Water Resource Inventory Area #) using the WDF Catalog of Washington Streams and Salmon Utilization and a DeLorme Atlas of Washington State. Stream crossings were also identified by highway mile. After identification of the stream crossing, data on the culvert were collected using a WDFW / WSDOT Culvert Report form (Appendix VI). If the culvert appeared 100% passable to salmonids, data was collected only on its size and location. The passability estimate represents the percentage of fish expected to pass, of those that approach the culvert and require passage. Passability varies with flows, species, and tidal influence. If the culvert posed a passage problem to salmonids, a passability estimate was made, and more detailed information was collected. This information included the slope and length of the culvert, the dimensions of the plunge pool, mean annual precipitation, substrate composition, and inlet information, as well as other data[3]. A photo was also taken of each barrier culvert. Culverts in local drainage ditches or those on streams with natural barriers (high gradient, waterfalls) located immediately up- or downstream of the highway were not evaluated; in most of these cases, the stream name and culvert size information was collected, and a code of NA (no access up to the culvert) or NG (no habitat gain above the culvert) was noted in place of a passability estimate. The decision whether or not to evaluate a culvert was made by the inventory team at the site.

Following the inspection of culverts, a prioritized list of barrier culvert sites needing further evaluation was developed for each District. The sites were prioritized using the passability, basin area, habitat quality, feasibility of construction, and species estimates obtained during the culvert evaluation. Fish presence verification, downstream passability, and habitat measurement proceed according to this listing, beginning with those streams highest in priority. Therefore, the first streams investigated are those with the highest potential benefit to fish production.

Phase II - Fish Presence / Downstream Passability Verification

To ensure that barrier correction projects will not be undertaken in areas which are not accessible to fish, the second phase of the inventory entails verification of fish presence in each stream on which a barrier culvert has been found, along with downstream surveying to determine if salmonids have access to each barrier culvert[4]. Species present are identified using information from WDFW Regional Habitat Program Managers and Area Habitat Biologists, local biologists and residents, the Catalog of Washington Streams and Salmon Utilization, the WDFW Spawner Survey database, and any other available information. Species may also be identified by electroshocking the stream, using a portable backpack electrofisher.

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[3] The culvert form has undergone several changes since the Fish Passage Inventory began. These changes include the addition of several pieces of information about barrier culverts, including: Depleted Stock and Cost Codes (Priority Index, p.11), Habitat Quality (ranked 1-10), Feasibility (ranked 1-10), and Road Fill Height / Ease of Access (ranked 1-10) (Appendix VI).

[4] Areas not accessible to anadromous fish may receive attention in the future, since non-anadromous fish also benefit from increased habitat availability.

Downstream verification of passage entails walking the stream from the barrier culvert to the mouth. Any impediments to salmonid passage are documented. Culverts with natural barriers such as falls or barrier cascades present downstream are generally not investigated in more detail as potential projects (at some point in the future, after resolution of higher-priority projects, they may be given further consideration). If a resolvable artificial barrier is located downstream, the stream is surveyed.

Phase III - Habitat Measurement (Physical Surveys)
Once downstream fish passage has been verified, measurement of the amount of fish habitat blocked by each impassable culvert is conducted. Physical habitat surveys estimate the amounts of spawning and rearing habitat upstream of the culvert in square meters (m^2). The habitat values are components of the Priority Index model, which is used for prioritization of potential projects (Priority Index, p.11). Habitat evaluation and measurement begin at the barrier, and proceed upstream. In addition to measuring the length of usable stream above the culvert, surveys divide the stream into habitat types: pools, riffles, rapids and ponds. This is done by sampling 30-meter portions every 161 meters (one-tenth mile) more intensively (60-meter portions every 322 meters in streams greater than one mile in length). Within sample areas, habitat types (riffle, pool, rapid and pond) are delineated and measured, streambed substrate composition (percentage of boulder, rubble, gravel and sand) within each type is estimated, and the stream gradient is measured. The samples result in an estimated ratio between habitat types which is then applied to the total length of the stream to obtain total riffle, pool, rapid and pond areas. These areas are then used to calculate spawning and rearing areas (see below). Any artificial barriers to salmonid passage are also documented. Measurement of habitat proceeds upstream from the barrier culvert until a natural barrier is reached, the stream is too small for salmonid use, or gradients consistently exceed seven percent.

The methods for both measurement and calculation of the amount of rearing and spawning habitat potentially available upstream of barrier culverts have undergone major changes during the 1993-1995 biennium. Revision of the existing methodology (Legislative Report, Biennium 1991-1993, Appendix D) began in June 1993. The revised methodology is shown in Appendix VII. One major revision incorporated is the breaking of the stream into discrete reaches, defined by gradient, tributary junctions, and other major morphological changes. This results in the grouping of similar lengths of stream into the same reach.

Changes have also been made in spawning and rearing habitat area calculations. In the previous survey format, spawning area was defined as total riffle area. However, since spawning occurs mainly in late fall/early winter, when flows are at or near Ordinary High Water, and habitat types other than riffles may be used for spawning, this method can result in an underestimation of spawning area. The revised physical survey format defines spawning area as the sum of the areas of each habitat type at Ordinary High Water, multiplied by the habitat type's gravel percentage. The Ordinary High Water line is defined as the point where "the presence and action of waters are so common and usual and so long continued in ordinary years, as to mark upon the soil or vegetation a character distinct from that of the abutting upland" (WAC 220-110-020, 1994). Widths at Ordinary High Water are determined during the survey using the bank vegetation line, and other hydrologic evidence. Spawning area is then further multiplied by a Habitat Quality Modifier, which

LIMITING FACTOR - If a habitat quality modifier other than 1 is assigned to a reach indicate why in this space. A simple note will suffice (dairy waste, unstable bed, lacking riparian vegetation, lacking in stream cover, irrigation return water, stream dry, high summer temperatures etc.

SURVEY ALL POTENTIAL HABITAT ABOVE A BARRIER - We will eliminate the category "immediate habitat" and call all habitat above a barrier potential habitat. This will include habitat above secondary barriers upstream of subject barrier provided the barrier has a reasonable potential for correction. When secondary barriers are encountered their location should be entered into the "multiple barriers" space in your field data notebook as distance in meters above the primary barrier. This may be directly tied to the data base via the unresolved fish passage problem identification report which you are currently completing at each man made barrier located.

1) Stream length

a) A belt chain measuring in meters and using a 3 strand, biodegradable thread is worn, and the stream is walked from the downstream end of the survey area.
b) To determine total potential habitat available above a barrier, the survey is continued to a point when the gradient consistently exceeds 7.0 % for a distance of at least one tenth of a mile or an anadromous barrier is reached.
c) **MULTIPLE BARRIERS** Frequently, additional man made or temporary (beaver dam, log jam) barriers exist which must be corrected to realize the potential habitat gain above the primary barrier. In this case, note the river mile of each additional barrier in the "multiple barrier" space on your survey form and identify your method of river mile identification (chain belt, stream catalogue, aerial photo, USGS quadrangle).
d) A fish passage barrier identification form should be filled out and submitted for each man made barrier encountered.
e) The multiple barrier river mile locations will appear as an additional field in our fish passage database.

2) Sample Frequency

a) Where the survey is predicted to be over 1.0 mile long, sample sections are 60 meters in length and taken at the beginning of each 0.2 mile (322 meters) section of stream. b) Where the survey is predicted to be under 1.0 mile long, sample sections are 30 meters in length and taken at the beginning of each 0.1 mile (161 meters) section of stream. Note: Depending upon the location of the end of the survey, the rate of sampling calculates out to be no less than 18.6% of the total stream length surveyed.

T - 1000162

FISH PASSAGE PROGRAM

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
FISH PASSAGE BARRIER REMOVAL PROGRAM

Progress Performance Report

For

Fish Passage Inventory, Corrections and Project Evaluation

March 31, 1998

Submitted By:

Greg Johnson (Project Leader)
Susan Cierebiej-Kanzler
Larry Cowan
Jim Lenzi

Washington Department of Fish and Wildlife
Lands and Restoration Services Program

Salmonid Screening, Habitat Enhancement and Restoration (SSHEAR) Division

Cause No. C70-9213, Sub. 01-1
Plaintiffs' Exhibit **AT-055**

Introduction

Inventory and correction of fish passage barriers associated with roadways and other structures is a growing priority for those who manage Washington's streams, lakes, and wetlands. Department of Fish and Wildlife, tribes, and private organizations have recently assessed fish passage at many culverts under state highways, county roads, and private driveways. As a result of these assessments, the difficulties salmonids face in accessing habitat once part of their historical range has become more apparent. The results of recent inventories in Washington estimate salmonids are currently blocked by barrier culverts numbering in the thousands.

This recurrent problem can be corrected cost effectively in most cases. In recognition of this, the Washington State Legislature, the Washington Department of Fish and Wildlife (WDFW) and the Washington Department of Transportation (WSDOT) have been cooperatively working to inventory, assess, evaluate, and correct culvert barriers located on stream crossings under state highways. (see Appendix I, for a summary of the WSDOT Barrier Culvert database).

WSDOT plans to address all the barriers with their 20 year System Plan. The 20 year System Plan is a three pronged approach. It first designates highest priority fish passage barriers and systematically removes these barriers utilizing Environmental Retrofit Program funding. Secondly, as Transportation Projects are programmed requiring hydraulics permits, additional fish passage barriers are removed. This approach leads to a decrease in barrier removal costs by combining projects and sharing the expense of mobilized equipment. And third, some fish barriers are removed as a result of normal WSDOT's maintenance activities.

Estimates of the number of barriers requiring correction have recently expanded to include stream reaches that benefit resident game fish species and habitat associated with stream gradients up to 20% slope. These changes were required to comply with current fish passage and stream typing statutes. The 20 year System Plan should be reviewed and updated to reflect these changes.

Evaluation of fish passage projects has also been given high priority in the WSDOT inventory and barrier correction. This insures completed fishways are functioning properly and providing durable and efficient fish passage that can increase fish production. To facilitate this a three-level culvert and fish use evaluation has been designed and implemented. Results are presented in Appendix II, Appendix III, and Appendix IV.

Documentation of corrected barriers, long term planning for future corrections, methodologies, and results of evaluations are the topics of this progress report.

Also outlined in this report is a six year WSDOT planning process to facilitate long term funding and correction of high priority barriers.

Project Evaluation for Dedicated Funding Projects, Before and After Barrier Removal

Working with recommendations and funding support from WSDOT, WDFW has developed a three level culvert and fish use evaluation procedure to be done on planned and completed dedicated funding projects. It is intended to determine utilization of the newly accessible habitat and remedy problems associated with fish production such as chronic low escapements, habitat degradation, or non point watershed problems. Level 1 is the initial evaluation to determine fish use prior to a project and during the one year guarantee period following the barrier correction. Level 1 evaluation is funded by WSDOT and is done on all projects (see Appendix II and Appendix IV). Level 2, funded by WDFW, is designed to monitor and make appropriate recommendations on streams where utilization of target species could not be documented (see Appendix III and Appendix IV). This may include electro-fishing and/or spawner surveys lasting as long as two brood cycles (e.g. six years for coho). Level 3 evaluation is geared to measure the actual increase in production realized on a small number of selected streams over a long term.

It should be noted that Level 1 and Level 2 project evaluations are not designed to estimate resident or anadromous population size in target streams. Further, it is not an escapement estimate, and is not an enumeration of smolt production. Procedures such as these are site specific, detailed, and expensive salmonid studies beyond the current scope of this project. The evaluations are intended to identify the presence or absence of target species in a stream where fish passage is being scrutinized.

Purpose and Intent

WDFW evaluates completed projects to assure they are successful in achieving free and unobstructed fish passage. After constructing a fish passage project with dedicated funding a one year guarantee period allows for observation of conditions during winter flows when fish typically use the facility. We observe hydraulic conditions in the fishway and foot survey stream reaches above and below the project for adult spawners and/ or evidence of juvenile use (electro-fishing). During this time, if deficiencies in passability of the structure, or deficiencies that could reduce the normal expected project life are detected, plans are made to effect corrections. We have found that utilization of newly opened habitat is heavily influenced by adult spawner run strength which varies annually in response to an entire matrix of environmental and fish harvest conditions. Many species of salmonids such as coho and steelhead seek out cover and effectively avoid detection. These species also tend to disperse widely in stream systems making it difficult to observe them when numbers are low. In some cases, fish production in quality streams may be low due to many factors - including existence of the initial barrier culvert, low escapements, habitat problems in the target stream unrelated to the barrier, and inadequate time for fish production to cycle up on a stream blocked by a barrier culvert for many decades.

On Site Project Inspection

An on site review consists of physical assessment by project team members to confirm that the new fishway is functioning as designed to freely pass fish. Any structural/fish passage deficiencies are identified and corrected during this time period which begins immediately after project construction and ends on December 31 the year following. All work within the first year after project inspection is classified as a Level 1 evaluation.

Adult Spawner Surveys

The primary objective for adult spawner surveys is to determine target species presence or absence above and below a newly completed WSDOT fish passage installation or to evaluate a WSDOT pre-project barrier. Spawner surveys are conducted for 500 meters above and below the project, or to the confluence with a larger body of water downstream, or to a natural barrier upstream. A belt chain is used to measure 500 meters upstream and downstream where surveyors tape is placed to mark the end of the survey area. Survey results are then recorded and copies forwarded to the WDFW Fish Management Program. If the reaches above and below the fishway are determined to be transport waters and local biologists indicate the likelihood of spawners elsewhere, the team relocates the survey accordingly. Pre- and post-project spawner surveys must be done (see Appendix II and Appendix III for results of adult spawner surveys).

Electro-fishing

Electro-fishing is primarily used to determine target species absence or presence above and below a newly completed WSDOT fish passage installation or to analyze a WSDOT barrier. It is intended to trigger appropriate action if for any reason fish are not responding to the barrier correction. If a project shows no fish use during the Level 1 evaluation (one year following completion of the project), the Level 2 evaluation begins a plan for recovery of target stocks so low in numbers that a practical, reasonable expectation for natural colonization is limited. This may continue for a period of six years depending on recovery of target species.

Juvenile electro-fishing and/or minnow trapping is used to determine target species presence if adult surveys indicate fish were found in extremely low numbers. An individual watershed approach is taken and problems associated with that specific watershed discussed by the SSHEAR evaluation team. An approach to fish recovery, if needed, is then prescribed for the specific stream being evaluated.

Generally, electro-fishing is done without block nets and within the first three pools or riffles above and below the culvert. Exceptions are made in those cases where known, high quality habitats that are more likely to hold juvenile fish, exist in areas other than this reach.

The primary result of juvenile studies is to verify fish use in streams where adult surveys have not verified adult use. These data, along with physical habitat information, are used by the with the stream in question are determined by the evaluation team. Details on the approach, level, intensity, and location of the evaluation are determined by the team.

Results and Discussion

In streams evaluated, fish showed a wide variety of responses to new fish passage facilities. It is important to note some fish runs are extremely low in Washington, and will take time, possible further enhancement effort, and key habitat and harvest management decisions for fish populations to rebuild. As expected, some newly opened habitats were immediately taken advantage of by fish populations, while others showed no measured recovery. Adult surveys, the primary evaluation technique, revealed 14 of the 21 new fishways had upstream escapement after project completion. Of the 13 fishways where electro-fishing was conducted, 6 were determined to have a significant population of target species above the new fishway, 7 did not and were determined to require further monitoring.

Streams not being utilized will be re-sampled for fish presence in subsequent brood years. If fish populations are not recovering, further steps will be taken to rebuild the depressed stock. Steps might include further analysis of upstream or downstream barriers, selective debris removal, fencing, beaver dam notching, repair of other human-made barriers in the system, or channel roughening in bedrock sections. The primary method reestablishment of extirpated fish stocks will be supplementation (fry or fingerling planting). A recommendation to pursue recovery using supplementation will be made to the WDFW Fish Management Program, if the Level 2 evaluation process shows a fish stock is not recovering on its own.

Six Year Planning Document

At the request of WSDOT, WDFW has prepared a prioritized list of projects to be implemented over the next three biennia. This list is the result of further project evaluation, development of on-site engineering plan, conceptual designs, and budgeting. The WSDOT fish passage project six year plan is included in Appendix VI.

ct

2007-2026 Budget Update

Paula Hammond
Secretary

David Dye
Deputy Secretary

Steve Reinmuth
Chief of Staff

Tim Smith
Manager
Systems Analysis and Program Development

WSDOT Statewide Construction Engineers Meeting
29 May 2008

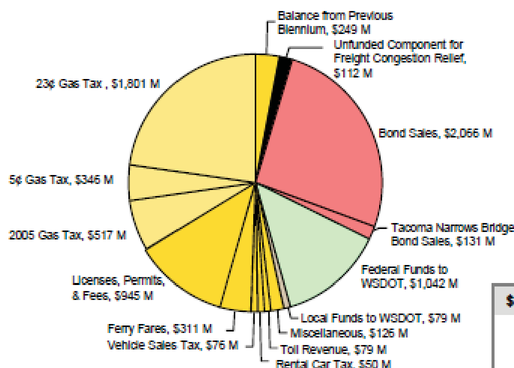
Washington State
Department of Transportation

Cause No. C70-9213, Sub. 01-1
Plaintiffs' Exhibit **AT-100**

T5000072 1

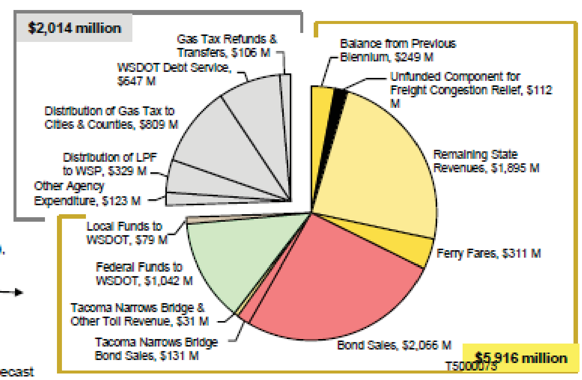
2007 - 2009 Enacted Budget

Transportation Revenues and Funds Collected by the State 2007-09 • $7.9 billion



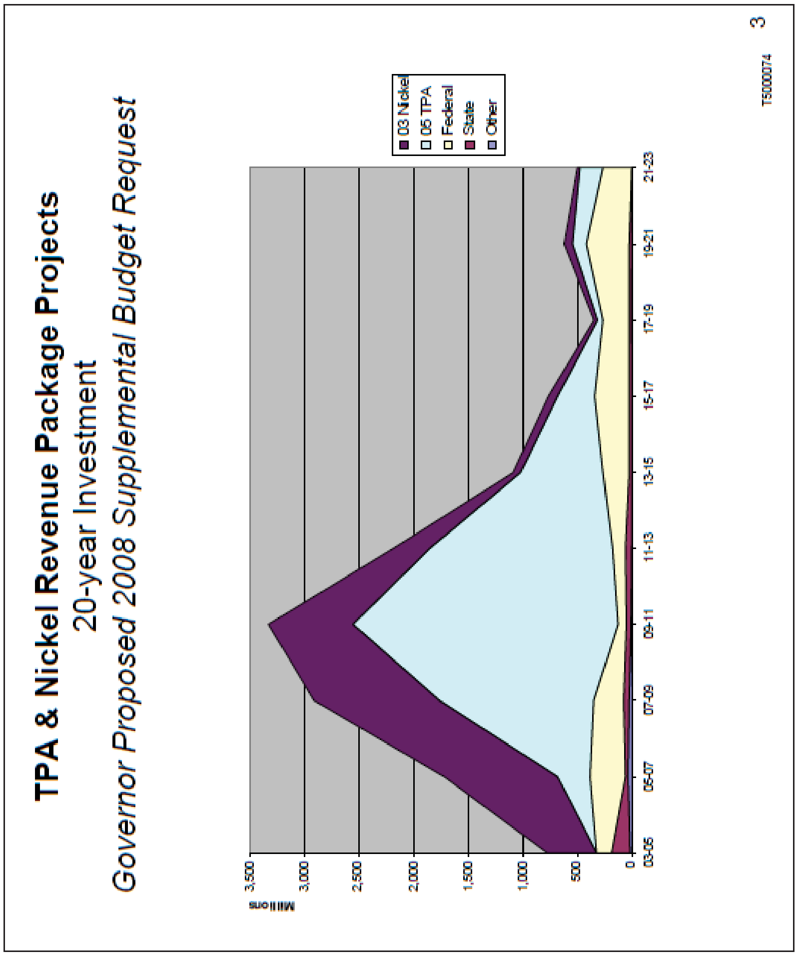
Funding for transportation comes from a variety of sources, including fuel taxes, licenses, permits, and fees, ferry fares and concessions, rental car taxes, and miscellaneous revenues like interest earnings. A portion of the budget is also funded from bond sales, federal funds, and local funds and remaining cash balances from previous years.

Distribution of State Collected Transportation Revenues and Funds 2007-09 • $2.0 B to other agencies and governments, $5.9 B retained by WSDOT



Out of the total collected funds, distributions are made to various agencies and governments. During the 2007-2009 biennium, of the estimated $7,930 million in transportation funds collected, WSDOT retains approximately $5,916 million. The remaining $2,014 million is distributed to cities and counties, the Washington State Patrol, the Office of the State Treasurer (to pay debt service), and other agencies.

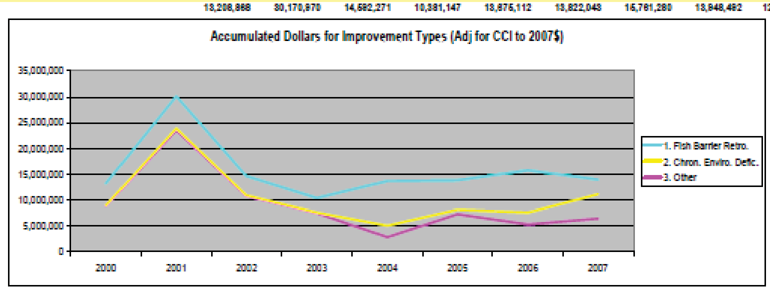
Revenue projections based on the June 2007 Transportation Revenue Forecast


TPA & Nickel Revenue Package Projects
20-year Investment
Governor Proposed 2008 Supplemental Budget Request
Millions
3,500
3,000
2,500
2,000
1,500
1,000
500
0
03-05
05-07
07-09
09-11
11-13
13-15
15-17
17-19
19-21
21-23
03 Nickel
05 TPA
Federal
State
Other
T500074
3

Subprogram Code This	Improvement Type Code	Improvement Type Description	2000 Current Dollars	2001 Current Dollars	2002 Current Dollars	2003 Current Dollars	2004 Current Dollars	2005 Current Dollars	2006 Current Dollars	2007 Current Dollars	Total Current Dollars
I4	CA	ADMINISTRATIVE SUPPORT	$3,145,768	$9,196,668	$3,426,885	$2,291,094	$201,025	$304,272	$471,578	$386,157	$19,423,446
I4	P	ENVIRONMENTAL				$0	$0	$0	$0	$0	$0
I4	P1	FISH BARRIER RETROFIT	$2,683,160	$4,055,901	$2,426,284	$1,849,258	$5,843,631	$4,280,451	$7,384,349	$2,822,291	$31,345,324
I4	P2	STORMWATER RETROFIT	$1,732,526	$4,665,704	$1,803,003	$1,230,269	$24,557	$75,713	$874,618	$1,762,967	$12,169,358
I4	P3	NOISE BARRIER RETROFIT	$144,813	$242,170	$432,515	$219,370	$1,679,670	$4,841,335	$2,460,513	$2,484,951	$12,505,337
I4	P4	CHRONIC ENV DEFICIENCY	$71,866	$232,203	$83,381	$73,502	$1,504,816	$651,176	$2,067,512	$4,687,198	$9,371,653
I4	P5	AIR QUALITY	$141,311	$303,007	$261,413	$465,148	$0	$6,312			$1,177,189
I4	P6	MGMNT OF ENVIRNMNTL MITIGATION	$389,835	$835,444	$1,090,856	$762,813	$19,527	$255,031	$970,851	$1,804,927	$6,129,284
Total			**$8,309,279**	**$19,531,098**	**$8,524,335**	**$6,891,453**	**$9,273,228**	**$10,414,290**	**$14,229,421**	**$13,848,492**	**$92,121,592**

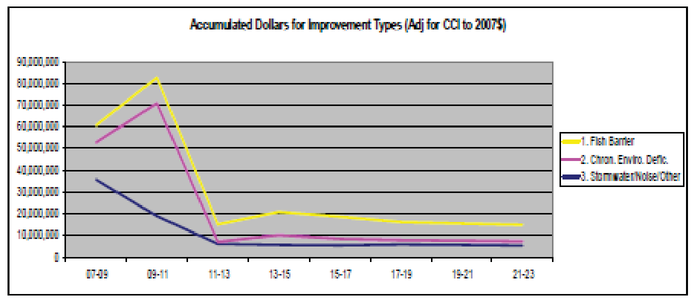
		2000	2001	2002	2003	2004	2005	2006	2007	Total
Summary of Totals by Improvement Type Classifications:										
	1. Fish Barrier Retro.	$2,683,160	$4,055,901	$2,426,284	$1,849,258	$5,843,631	$4,280,451	$7,384,349	$2,822,291	$31,345,324
	2. Chron. Enviro. Defic.	$71,866	$232,203	$83,381	$73,502	$1,504,816	$651,176	$2,067,512	$4,687,198	$9,371,653
	3. Other	$5,554,253	$15,242,992	$7,014,671	$4,968,693	$1,924,779	$5,482,664	$4,777,560	$6,439,003	$51,404,614
Grand Total:		**$8,309,279**	**$19,531,098**	**$8,524,335**	**$6,891,453**	**$9,273,228**	**$10,414,290**	**$14,229,421**	**$13,848,492**	**$92,121,592**
Construction Cost Index (CCI):		141.1	145.2	146.4	148.9	152.1	169.0	202.5	224.3	

		2000	2001	2002	2003	2004	2005	2006	2007	Total
Summary of Totals by Improvement Type Classifications:										
	1. Fish Barrier Retro.	4,265,293	6,265,417	3,717,318	2,785,685	8,617,530	5,681,096	8,179,306	2,822,291	42,333,936
	2. Chron. Enviro. Defic.	114,241	358,700	127,748	110,722	2,219,134	864,253	2,290,089	4,687,198	10,772,084
	3. Other	8,829,334	23,546,853	10,747,205	7,484,740	2,838,448	7,276,695	5,291,885	6,439,003	72,454,162
Grand Total in 1007$		**13,208,868**	**30,170,970**	**14,592,271**	**10,381,147**	**13,875,112**	**13,822,043**	**15,761,280**	**13,848,492**	**126,560,182**



T5000100

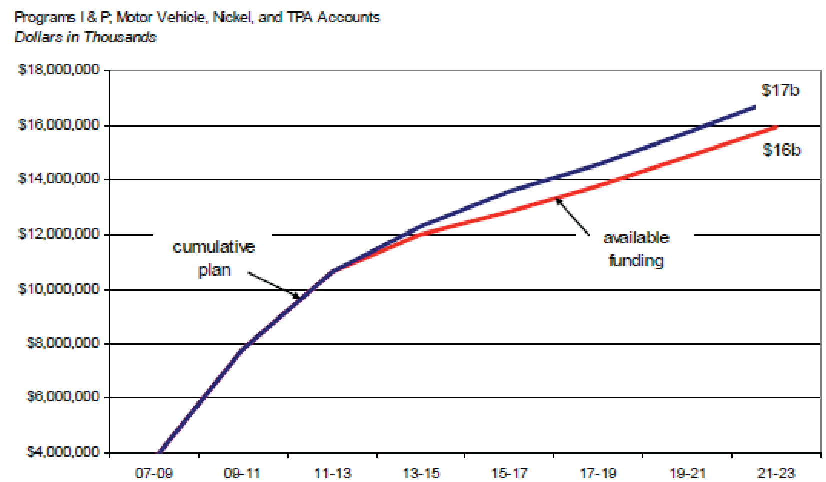
SubPgm	Improvement Type Description	Total	Prior	07-09	09-11	11-13	13-15	15-17	17-19	19-21	21-23	Future
I4	Chronic Environmental Deficiency	95,698,254.00	6,916,908.00	17,478,010.00	54,303,335.00	1,000,000.00	5,000,000.00	3,500,000.00	2,500,000.00	2,500,000.00	2,500,000.00	0.00
I4	Fish Barrier Retrofit	95,234,211.00	12,383,211.00	7,997,006.00	12,347,468.00	8,723,922.00	11,949,604.00	11,833,000.00	10,000,000.00	10,000,000.00	10,000,000.00	0.00
I4	Mgmt of Environmental Mitigation Sites	32,370,934.00	2,332,701.00	4,749,353.00	5,190,950.00	4,608,133.00	3,288,939.00	3,161,935.00	3,038,923.00	3,000,000.00	3,000,000.00	0.00
I4	Noise Barrier Retrofit	53,252,820.00	7,182,742.00	27,310,644.00	12,586,334.00	673,099.00	1,500,000.00	1,000,000.00	1,000,000.00	1,000,000.00	1,000,000.00	0.00
I4	Stormwater Retrofit	22,460,364.00	836,131.00	4,477,228.00	2,119,005.00	1,500,000.00	1,680,000.00	2,237,000.00	3,183,000.00	3,217,000.00	3,211,000.00	0.00
		299,016,583.00	29,651,694.00	62,012,241.00	86,547,092.00	16,505,154.00	23,418,543.00	21,731,935.00	19,721,923.00	19,717,000.00	19,711,000.00	0.00
	Summary of Totals by Improvement Type Classifications:											
			1. Fish Barrier	7,997,006	12,347,468	8,723,922	11,949,604	11,833,000	10,000,000	10,000,000	10,000,000	0
			2. Chron. Enviro.	17,478,010	54,303,335	1,000,000	5,000,000	3,500,000	2,500,000	2,500,000	2,500,000	0
			3. Stormwater/Nc	36,537,225	19,896,289	6,781,232	6,468,939	6,398,935	7,221,923	7,217,000	7,211,000	0
	Grand Total:			**62,012,241**	**86,547,092**	**16,505,154**	**23,418,543**	**21,731,935**	**19,721,923**	**19,717,000**	**19,711,000**	**0**
	Construction Cost Index (CCI):		224.3	229.0	234.6	243.6	251.5	260.3	271.7	283.3	295.0	
	Summary of Totals by Improvement Type Classifications:											
			1. Fish Barrier	7,832,177	11,804,306	8,032,025	10,656,291	10,195,564	8,254,693	7,916,696	7,602,712	
			2. Chron. Enviro.	17,117,765	51,914,544	920,690	4,458,847	3,015,674	2,063,673	1,979,174	1,900,678	
			3. Stormwater/Nc	35,784,143	19,021,056	6,243,410	5,768,802	5,513,458	5,961,475	5,713,480	5,482,316	
	Grand Total in 1007$			**60,734,085**	**82,739,905**	**15,196,125**	**20,883,940**	**18,724,696**	**16,279,841**	**15,609,350**	**14,985,705**	



T5000101

Highway Const. Program Plan vs. Available Funding

Governors proposed 2008 Supplemental Request



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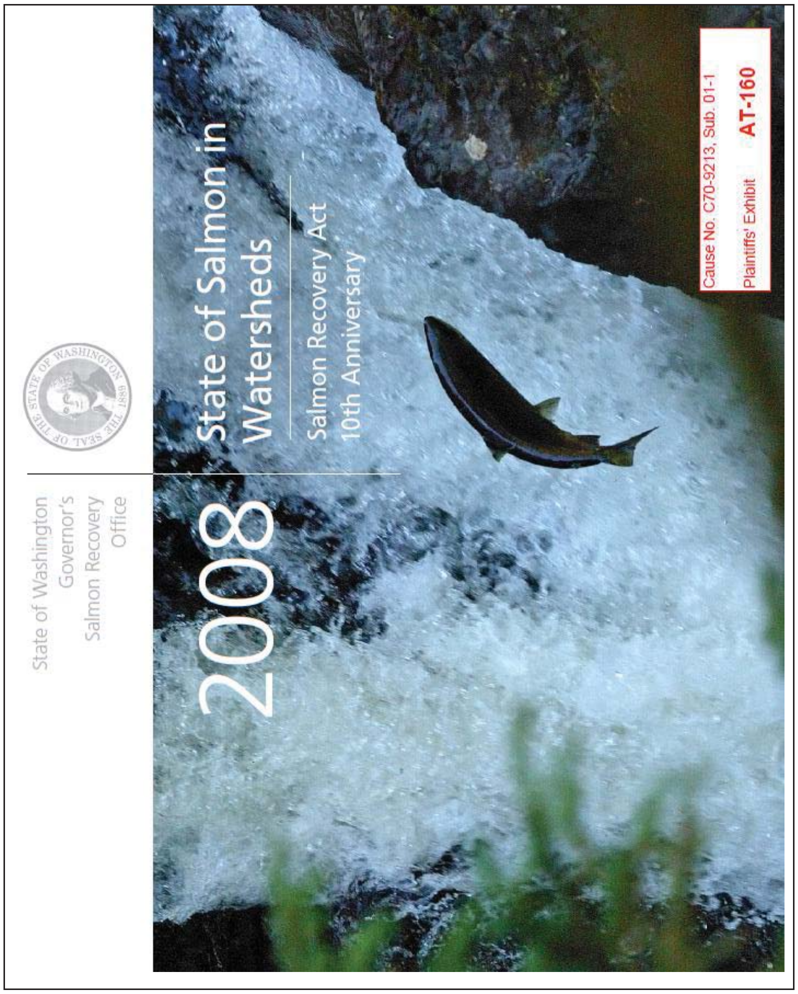
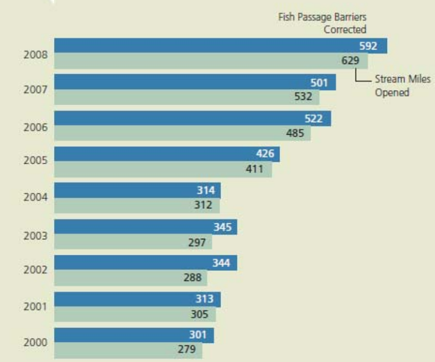

State of Washington
Governor's
Salmon Recovery
Office
2008
State of Salmon in
Watersheds
Salmon Recovery Act
10th Anniversary
Cause No. C70-9213, Sub. 01-1
Plaintiffs' Exhibit
AT-160

Water Quality in Watersheds

- Water quality is measured by **Water Quality Index (WQI)**. This is a number that aggregates water quality data at a monitoring station for temperature, pH, fecal coliform bacteria, dissolved oxygen, expected nutrients, and sediments over a 12 month period.
- 62 sampling stations are monitored statewide in 39 watersheds.
- A water year runs from October 1 until September 30.

DATA SOURCE: WASHINGTON DEPARTMENT OF ECOLOGY

Fish Passage Barriers Corrected and Stream Miles Opened



- Number reflects the estimated number of barriers corrected statewide in a given year. Because of incomplete reporting, these numbers are expected to be lower than actual values.
- Miles reflect the number of miles that are estimated to be opened as a result of barrier correction by year.

DATA SOURCES: WASHINGTON DEPARTMENT OF FISH AND WILDLIFE, WASHINGTON DEPARTMENT OF NATURAL RESOURCES, WASHINGTON DEPARTMENT OF TRANSPORTATION, SALMON RECOVERY FUNDING BOARD, FORESTS AND FISH, TRIBES AND LOCAL GOVERNMENTS. US FOREST SERVICE DATA AND BUREAU OF LAND MANAGEMENT INCLUDED AFTER 2002

F0013128

Strategy

STATEWIDE STRATEGY TO RECOVER SALMON

EXTINCTION IS NOT AN OPTION

November 1999

Cause No. C70-9213, Sub. 01-1

Plaintiffs' Exhibit AT-184

I. A Sense of Urgency

Overview

Salmon, steelhead and trout[1] have been, and continue to be, a critical part of Washington's history, culture, economy and recreational enjoyment. They are a basic and important natural resource, a symbol of the natural beauty of the state. Salmon are also valued for subsistence, for nutritional health and for the spiritual well-being of tribal people.

Salmon have been vital to the sport and commercial fishing industry. Fishing provides jobs, supports businesses, and provides quality recreational experiences for a significant number of families from Washington, around the country and the world. For example, the U.S. Department of Commerce estimates that in 1996 sport fishing contributed more than $704 million to Washington's economy. The decline of salmon is affecting families, communities, the state and the northwest region as a whole. The loss of salmon also means the loss of revenue for tribal economies historically dependent on salmon.

Much has been written on salmon biology and their environmental needs and the increasingly adverse impacts on salmon populations and habitats caused by human activities. (See Chapter VII. C for list of references.) Elsewhere in this document you'll find basic information on salmon problems and the potential consequences of the listing of the salmon as endangered or threatened under the federal Endangered Species Act. This chapter conveys the importance of taking actions now by preventing further harm to salmon populations and habitats, and by implementing long-term conservation measures and programs to reverse the decline and recover the salmon.

An Indicator of Quality of Life

Salmon life history takes them through many ecosystems - riverine to estuarine to marine and back again. Salmon are important indicators of the aquatic and riparian ecosystems they inhabit. The well-being of salmon is also an indicator of the health of many other species, as well as an indicator of the environmental quality and health of ecosystems. This includes indications of health for human uses, from drinking water to swimming.

Sustained salmon productivity can be maintained only if diverse biological communities and genetic diversity of salmon are maintained, and watersheds and ecosystems are healthy and properly functioning. The basic needs for salmon spawning, rearing and migration are:
- adequate amounts of cool, clean and well-oxygenated freshwater;
- fully functioning riparian corridors with large woody debris in the stream channel;

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[1] For the purposes of the Strategy, the term "salmon" will be used to refer to all species of salmon, steelhead, trout and char native to Washington State.

- high quality estuarine, nearshore and marine habitats;
- adequate supply of food, cover and refuge from predators;
- unimpeded access to and from freshwater.

Unfortunately, human activities have altered most, if not all, of these basic needs. Salmon are battling for survival, with their populations and habitats either at critical levels or at risk. Many wild salmon stocks have been significantly depleted and are being driven to or near extinction.

A Symbol in Decline

Salmon populations were historically numerous and abundant in the rivers of the state and along the Pacific Coast. The Columbia River with 1,210 miles was the greatest producer of wild salmon in the nation, with 10 million to 16 million salmon produced annually. Salmon runs now range from 3.2 million to less than a million, 75% of which are from hatcheries.

Fluctuations in the abundance of salmon have been observed for several decades. While some of the declines are normal and reflect the natural variation in ocean, freshwater and estuarine environments, human activities have severely accelerated the rate of decline of several salmon populations. For more than two decades scientists and fisheries experts have warned of the decline of salmon and the degradation of their ecosystems. Various stock status reviews have noted the decline of salmon in Washington. For example, the 1993 Salmon and Steelhead Stock Inventory (SASSI) stated that less than 50% of Washington's salmon stocks were in a healthy state. As defined in SASSI, a healthy stock is one "experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock." Generally, coastal populations currently tend to be better off than populations inhabiting interior drainages. Losses of stocks in inland areas of the Columbia River system have occurred over a greater percentage of their range than species primarily limited to coastal rivers.

Stress Factors

Declines of wild salmon closely parallel the settlement of the Pacific Northwest by Euro-Americans, starting in the early 1800s. For more than a century, people degraded and destroyed streams, rivers and estuaries by farming, logging and developing land and water; over-fished; introduced non-native species; and substituted hatchery-produced fish for wild fish.

Unfavorable natural conditions contributed additional stress. It is important to note that the effects of natural disturbances (e.g., droughts, fires, volcanic eruptions) are quite different from the effects of human-caused factors. Natural disturbances are usually relatively short in duration and occur on an infrequent basis. While human factors may contribute minimal impacts individually, the number, magnitude, duration, and cumulative impacts since settlement combine to form the primary cause of the decline of numerous salmonid stocks.

The degradation or modification of habitat conditions by human activities influences salmon growth, reproduction, migration, demand for food and other biological and physiological functions. For example, alteration of stream flows can interfere with upstream migration of adults, and reduce or eliminate stream rearing and spawning habitats. Many of the human impacts are interrelated and are cumulative in their effect. For example, a heavily over-fished stock has fewer spawners and is far less able to adapt to changing habitat conditions related to land use practices, such as urbanization or logging. Dams that block access to large areas of upstream habitat may fragment and reduce the genetic and biological diversity of a species in a basin to the extent that it may be unable to withstand further impacts from fishing, poor land use practices or interbreeding with hatchery fish.

Human factors have taken place over a long period of time and have affected particular salmon stocks or watersheds to varying degrees. Future population growth - projected by the Office of Financial Management (OFM) to increase by 36% between now and 2020 - and its associated continued urbanization and land disturbances will more likely expand the geographical extent and intensity of habitat loss.

These human factors are addressed in the Statewide Strategy to Recover Salmon in terms of the "four H's" - habitat, hydropower, harvest and hatcheries. By keeping the strategy focused on key human activities and actions (e.g., forest practices, agricultural practices, fish harvest, etc.) we hope to focus attention on the effects of those activities and the changes we need to make to protect and restore salmon and watershed health.

ESA Listings of Salmon: Difficult Issue for All

The protection of salmon populations and habitat occurs under several federal and state laws. Unfortunately, the decline and continuing losses of salmon stocks, as well as diminished abundance and genetic diversity, is evidence that some of the laws are either inadequate or not fully implemented and enforced. The declining status of many salmon species and populations has resulted in their listing as either endangered or threatened under the federal Endangered Species Act (ESA).

The listings of anadromous fish present new and difficult issues for the state, particularly in the heavily populated Puget Sound area, and there is little historical precedence or experiences upon which to draw. Now, or in the very near future, key regulatory mechanisms of the ESA, such as prohibition against taking or harming a listed species, (which includes significant habitat modification or degradation), may be triggered. This will require all of us to change our behavior, from how we water our lawns to how we grant approval to new projects.

In summary, salmon play a critical role in our economy and way of life. But they are facing an uphill battle for survival. No specific factor is solely responsible for the salmon problem. Salmon have evolved to withstand natural disturbances such as floods, drought, predation and ocean cycles. However, these disturbances are often accelerated by human factors. Given that the stresses to fish populations posed by low points in natural ocean productivity cycles can occur over a decade or more, continually shrinking freshwater habitat presents very serious risks. In addition, many human factors contribute directly to the salmon problem, such as forest and agricultural practices, water use and development, intensive and continued urbanization, fish harvest and hatcheries. The listings across 75% of the state are cause for great concern, and will have direct consequences for any actions taken that might harm the species or its habitat.

H-00002478

Update on Anadromous Fish Passage Culvert Barriers on Forest Service Roads within the US v. Washington Case Area

Bob Metzger
Aquatic Program Manger
Olympic National Forest, USDA Forest Service
July 1, 2009

Fish passage barrier inventories were initiated by National Forests throughout the Pacific Northwest Region in 2000 to collect initial information on potential culvert fish passage barriers on Forest Service roads. As of 2002, preliminary results identified 65 culverts within the case area that blocked access to ¼ mile or more of anadromous habitat. These culvert barriers blocked access to a total of 35.2 miles of anadromous habitat. Additional inventories since 2002 have provided more detailed information about potential fish barrier culverts within the case area and have caused some initial barriers to be deleted and some other sites to be added.

The Forest Service has implemented an aggressive program to correct culvert fish passage barriers throughout the Pacific Northwest Region. New crossing structures are designed to meet stream simulation standards to provide passage for all species and all life stages of fish by Regional direction. The 2005 MOU between WDFW and the Forest Service Regarding Hydraulic Projects Conducted by Forest Service in Washington State also requires the use of the stream simulation approach for new culverts on fish-bearing streams. Site investigation and selection of appropriate stream simulation designs are guided by the 2008 Forest Service document *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings.*

Where road segments that contain the culvert fish passage barriers are no longer needed, fish passage barriers are corrected by removing the crossings altogether and decommissioning the roads. In some cases, storms have washed out the barrier culverts and restored access for anadromous fish. Fish passage structures will be installed at these sites if the flood damage is repaired.

Fish passage has been restored at 36 anadromous culvert fish passage barriers on Forest Service roads within the case area since 2002. Completed culvert barrier correction projects are reported annually to WDFW and to the US Army Corps of Engineers as part of our Hydraulic Projects MOU and Corps 404 Permit RGP for Forest Service Fish Projects in Washington State, respectively.

There are currently 27 culvert fish passage barriers within the case area that block more than ¼ mile of anadromous habitat. These culverts block access to a total of 19.3 miles of anadromous habitat.

Table 1. Anadromous Culvert Fish Passage Barriers within case area			
Forest	# Culvert Barriers	Habitat Blocked	
Olympic	5	8.7 miles	
Mt Baker-Snoqualmie	22	9.6 miles	
Gifford Pinchot	0	0	No anadromous culverts within case area
Okanogan-Wenatchee	0	0	No fish culverts within case area
Total	27	19.3 miles	

At least three anadromous culvert barrier correction projects have been funded and will be implemented within the case area in FY 2009 or 2010. Two anadromous barriers will be removed on the Olympic National Forest. One culvert will be corrected on the Mt. Baker- Snoqualmie National Forest. These projects will reestablish access to another 5.1 miles of anadromous habitat. Additional culvert barrier corrections are in the planning and design phases on both Forests and will be implemented as funding is available.

Design of Road Culverts for Fish Passage

2003

Design of Road Culverts for Fish Passage

Guiding Principles for Water Crossings:

1. Culverts result in permanent, direct loss of instream and riparian habitat.

2. Installation and maintenance of water crossings that confine or constrict the channel or floodplain will break ecological connectivity, alter channel processes and change adjacent channel character and shape by affecting the movement of debris, sediment, channel migration, flood waters, and aquatic and terrestrial organisms.

3. Water crossings may create an entry point for road-runoff pollutants.

4. Fish passage can be hindered or blocked at water crossings.

5. Water crossings increase the risk of damage to the downstream habitat due to water crossing failure.

6. Cumulative impacts and risks of water crossings can be avoided or minimized by consolidating water crossings; employing full-span bridges, by simulating a natural channel through culverts; or removing water crossings. Access solutions that do not require water crossings are preferred.

It is our nature as human beings to live, work and recreate along and adjacent to waterways, whether freshwater or marine. Our lives and histories are inextricably linked to water. How we affect those waterways has long-term survival consequences not only for fish and wildlife, but for humanity. The Aquatic Habitats Guidelines Program is intended to help balance man's need to protect life and livelihood with the need to protect and restore valuable habitat for fish, for wildlife and for ourselves.

Introduction

Design of Road Culverts for Fish Passage serves as guide for property owners and engineers who are designing permanent road-crossing culverts to facilitate upstream fish migration. It provides guidance for projects involving new culvert construction as well as retrofitting or replacing existing culverts. The designer will need to have a working knowledge of hydraulic engineering, hydrology and soils/structural engineering to accomplish an appropriate design.

Formal fish ladders may be required as a retrofit at some culvert sites to provide passage. The design of fish ladders is beyond the scope of this guideline, though there is a brief description of some basic design concepts included here. An engineer with expertise in fish passage should be consulted for additional assistance for the design of fish ladders.

Design of Road Culverts for Fish Passage lays out the consecutive design steps most likely to be required in a culvert project. A form describing the data needed for the design and its evaluation is provided in Appendix F, *Summary Forms for Fish-Passage Design Data*. Explanations and definitions of terms describing channel, hydrology and data requirements can also be found in Appendix F.

Before using this guideline, great care should be taken to determine whether a culvert is a suitable solution for providing fish passage at the particular site in question. Indeed, environmental circumstances other than fish passage may make it impossible to obtain a permit to install a culvert. The Washington Department of Fish and Wildlife prefers construction of a bridge over installation of a culvert in order to minimize risk of impacts to fish and habitat. Wherever a roadway crosses a stream, it creates some level of risk to fish passage, water quality or specific aquatic or riparian habitats. Generally, the risks increase the more the roadway confines and constricts the channel and floodplain. Any and all alternatives should be investigated to minimize the number of sites where a roadway crosses a stream, including designing road alignments to avoid crossings, consolidating crossings and using temporary crossing structures for short-term needs.

Though this guideline focuses on fish passage, other habitat and ecological considerations are also required in the siting and design of road-crossing structures such as culverts. These considerations are essential to the protection of fish and habitat, and should be addressed first in the design of a road crossing. Requirements addressing these considerations are outlined in Chapter 1, *Habitat Issues at Road Crossings*. The Washington Department of Fish and Wildlife's Area Habitat Biologist in the area where your project is located is the final authority for Hydraulic Project Approval, so be sure to make contact early on for information on fish passage and other environmental issues that go beyond fish passage (see Appendix J, *Washington Department of Fish and Wildlife Contact Information*).

For information about the inventory of culverts or the prioritization of culvert barrier remedies, refer to the *Fish Passage Barrier Assessment and Prioritization Manual*, published by the Washington Department of Fish and Wildlife (1998).

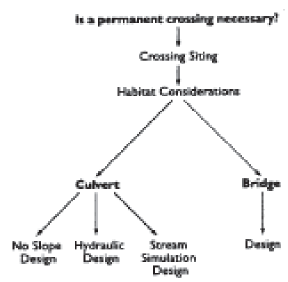
The design of new or retrofit culverts must be in compliance with Washington Department of Fish and Wildlife fish-passage criteria as defined by WAC 220-110-070 (see Appendix B, *Washington Culvert Regulation*). The information contained in this publication is the most current guidance for construction and retrofit of culverts for fish passage in Washington State. Recommendations in this publication vary somewhat from WAC 220-110-070 but do not conflict with it. *Design of Road Culverts for Fish Passage* is intended to clarify the regulation and provide up-to-date guidance and application of the regulation across a broader range of fish-passage projects, including steep culverts. These guidelines can be applied as provided for in WAC 220-110-032, "Modification of technical provisions." Information gathered, as well as concepts and guidance developed for this publication will be incorporated into any future review and update of WAC 220-110-070.

Chapter 1 – Habitat Issues at Road Crossings

The very presence of a culvert has an impact on stream habitat, even when fish are able to migrate through it successfully. These impacts are often associated with the culvert itself, but they can also be associated with the channel modifications necessary to install or retrofit a culvert intended to facilitate fish passage. Upstream and downstream hydraulic effects of the culvert can have an impact as well. There are, for example, often habitat losses associated with steepening a channel to achieve fish passage. What's more, though fish-passage criteria apply only to fish-bearing streams, other environmental factors apply at all crossings. For questions about habitat issues, contact the Washington Department of Fish and Wildlife's Area Habitat Biologist (see Appendix J, *Washington Department of Fish and Wildlife Contact Information*).

Because the impact to stream habitat can be significant, the best option for roadway design is to avoid or minimize the number of stream crossings needed. However, this is not always feasible, so other options must be considered that will allow the stream to cross the road. **Figure 1-1** presents a generalized approach to selecting road-crossing options. As you can see, it explores options other than permanent culverts and addresses habitat issues that may arise before considering the formal culvert-design process.

Figure 1-1. Road Crossing Design Process



A generalized approach to selecting road-crossing options.

Once the culvert option has been selected, a number of concerns must be taken into account as design begins. These concerns may dictate the siting, sizing and design of culverts and/or fish passage improvements:

- direct habitat loss,
- water quality,
- upstream and downstream channel impacts,
- ecological connectivity,
- channel maintenance,
- construction impacts, and
- risk of culvert failure.

Direct Habitat Loss

Salmonid habitat includes all areas of the aquatic environment where the fish spawn, grow, feed and migrate. Culvert installations require some magnitude of construction activity within the stream channel, and the culvert itself replaces native streambed material and diversity with the culvert structure.

Spawning Habitat

Each species of salmon and trout require specific spawning conditions related to the water velocity, depth, substrate size, gradient, accessibility and space. All salmonids require cool, clean water in which to spawn. Most salmonid spawning occurs in pool tailouts and runs. Spawning habitat can be lost or degraded by culvert installations in the following ways:

- Culvert placement in a spawning area replaces the natural gravel used for spawning with a pipe. This is a direct loss of spawning habitat.
- Culvert construction can require significant channel realignment, eliminating natural meanders, bends, spawning riffles and other diversity in the channel that serve as valuable habitat.
- Culverts shorten channels, leading to increased velocities and bed instability that reduce spawning opportunities and decrease egg survival.
- Riffles and gravel bars immediately downstream of the culvert can be scoured if flow velocity is increased through the culvert. Gravel mobilization while eggs are incubating in redds (nests) results in high egg mortality.

- Any release of sediment into the stream may smother spawning gravel with silt. In the case of culverts, sediment releases may be due to construction or due to a change in hydraulics caused by changes to the alignment, siting or design of the culvert. Such damage can be avoided or at least minimized by correctly designing and implementing an effective erosion- and sediment-control plan and by timing the project to avoid critical stages in salmonid life cycles. Instream work windows vary among fish species and streams. Contact the Washington Department of Fish and Wildlife's Area Habitat Biologist for information on work windows (see Appendix J).

Rearing Habitat

Juvenile salmonids use almost all segments of the stream environment during some stage of their freshwater residence. Habitat usage is highly variable depending upon the species, life stage and time of year. Pools with large woody debris are especially valuable habitat. Trees on the streambank also provide important habitat features, serving as cover and a source of insects and large woody material, both of which critical to rearing fish. Culvert construction can negatively impact rearing habitat in the following ways:

- There is a direct loss of rearing habitat when it is replaced with a pipe.
- Trees and woody debris at the culvert site must be removed to install the culvert, thus eliminating their beneficial effects on channel structure, function, stability and food production.
- Riparian vegetation must be removed from the streambank to make way for the culvert installation, and it is often removed for the entire right-of-way width as a regular maintenance activity.
- Any reduction in stream length is a reduction in usable rearing habitat. Culverts cut off natural bends, meanders, side channels and backwater channels, directly eliminating such habitat. Most side channels and backwater channels experience higher fish usage than the main stream channel, especially during winter flood flows, so the loss of such habitat can be especially harmful to fish survival.
- Culvert placement that lowers the natural water level of pools, ponds, backwaters or wetlands within or adjacent to the stream can significantly decrease valuable rearing habitat.

Loss of Food Production

Fish, like all other organisms, need food in order to survive, grow and reproduce. Juvenile salmonids feed on aquatic invertebrates and terrestrial insects that fall into the water. The food chain in the aquatic environment begins with the primary producers like algae and diatoms (periphyton), which require organic material and sunlight to fuel the photosynthetic process. The inside of a culvert is dark, and the absence of sunlight prohibits primary production. Benthic invertebrates like mayflies, stoneflies and caddis flies feed on the primary producers. Invertebrates require some of the same conditions as salmonids to thrive, including clean water and stable gravel. Reduction in the number of invertebrates means a reduction in an important food source for salmonids, which can reduce salmonid growth rates. Faster growth rates produce larger salmonids – a competitive advantage that increases their survival rate at sea.

Removal of riparian vegetation for culvert placement reduces organic debris such as leaves, wood, bark, flowers and fruit that enters the stream and fuels primary production. Terrestrial insects that drop from overhanging vegetation into the water are removed from the food base when the vegetation is lost.

Mitigation of Direct Habitat Losses

Complete replacement of habitat and channel length lost due to culvert installation can be difficult, if not impossible. Mitigation then becomes the next option. Mitigation for the impact of lost cover and pools might include adding diversity and habitat features such as woody debris to the channel in an appropriate location.

As mentioned earlier, placement of a culvert in a spawning area results in a direct loss of that habitat for fish, but invertebrates are also affected because they, too, spawn in gravel beds. Spawning habitat in most Pacific Northwest streams is not limited by the supply of gravel; it is limited by the structure and diversity of channel forms that sort and distribute bed material to create spawning and other habitats. The only effective means of preserving valuable spawning habitat in most cases is to avoid disturbing it in the first place.

In streams that are deficient in spawning gravel, a loss of spawning habitat might be mitigated off site by gravel supplementation. Several techniques might be used.

While it may be tempting to simply place new gravel over an existing streambed inside or outside of a culvert, it is normally not effective to do so in the short term. The new gravel is, of course, attractive to fish for spawning, but it's not stable enough for eggs to survive winter floods. It takes several high flows for gravel to be redistributed and settle into place before it can be valuable habitat.

Gravel supplementation should instead be done in a way that mimics natural gravel deposits such as pool tailouts or gravel banks. The downstream end of stable pools and stable riffles can be supplemented with a layer of gravel to mimic tailout deposits. Gravel can be placed upstream of streambed controls that are installed as part of the fish-passage project. A channel constriction made of mounds of gravel will, in the right circumstances, create a pool and a tailout. Gravel can also be supplied to a bankline to mimic a naturally eroding gravel bank. High stream flows will then efficiently redistribute the gravel to locations where it is most likely to remain stable.

It may seem reasonable to add a layer of gravel inside steeper culverts to mimic the streambed at either end. However, if the gravel layer is too thick, low water flows may not be able to rise above the gravel, and fish will not be able to swim through. This problem can be especially troublesome when there is no input of bedload from upstream to seal the gravels, such as when there is a wetland or pond immediately above the culvert or in spring-fed streams with stable hydrology.

Water Quality

To extend the life span of culverts in acidic water, they are sometimes treated with an asphalt coating. It is unknown what affect this may have on fish or invertebrates in the water. Until it can be shown that these type of treatments are not a risk to fish health they should not be used.

Quality and quantity of road stormwater runoff must be mitigated as deemed appropriate by the local jurisdiction or the Washington State Department of Ecology. In addition, all stormwater discharges into a stream must be designed to prevent scour during higher flows.

Upstream and Downstream Channel Impacts

Increased velocity from a culvert can erode downstream banks, leading to the need for bank protection. To reduce the likelihood of downstream erosion, flow velocity at the culvert exit should not exceed the preproject channel velocity by more than 25 percent.

Undersized culverts create bed instability upstream. At high flows, the culvert creates a backwater, and bed material is deposited in the channel upstream. With receding flows, the bed and/or banks erode through or around the deposition. The result is either a chronically unstable channel bed or increased bank erosion and the need for bank clearing and protection. The culvert inlet should be designed to limit head loss to less than one foot for a 10-year flood. Less head loss may be necessary considering flood impacts.

The design process described in this guideline helps minimize these upstream and downstream impacts. Typically, this process determines the size and elevation of culverts such that velocities leaving the culvert will not be excessive. Sites with banks or beds susceptible to erosion may require special consideration.

A culvert placed in a stream with an actively migrating channel can result in an acceleration of the channel migration and a substantial maintenance effort to keep the channel at the culvert location. Channel migration is a natural, geomorphic process, but upstream activities can accelerate it. Chapter 7, *Channel Profile* discusses how to anticipate and address those impacts.

Ecological Connectivity

Ecological Connectivity is the capacity of a landscape to support the movement of organisms, materials or energy.[1] In terms of culvert design, it is the linkage of organisms and processes between upstream and downstream channel reaches. The health of fish populations ultimately relies on the health of their ecosystems, which include migrations and processes that depend on that connectivity. Biotic linkages might include upstream and/or downstream movement of mammals and birds, nontargeted fish species, and the upstream flight and downstream drift of insects. Physical processes include the movement and distribution of debris and sediment and the shifting of channel patterns. Some of these functions may be blocked by road fills and culverts that are too small in relation to the stream corridor.

Debris and bed material should be managed by allowing them to pass unhindered through the culvert. When debris is trapped, fish-passage barriers are created; the debris is not passed to the channel downstream, and a backwater is created upstream that extends the negative effect of the culvert. While the size of the culvert developed by the design processes described in this guideline will normally be adequate to pass most debris and bed material, there may be special cases where the culvert size should be increased to avoid capturing debris. Additionally, the Hydraulic Design Option discussed later in this guideline may undersize the culvert for debris, so a factor of safety must be applied.

Trash racks and multiple, parallel, culvert pipes are generally not acceptable because they trap debris, create barriers to fish migration and increase the risk of culvert failure. In the case of low road profiles, raising the road elevation should be considered as an alternative to multiple culverts.

Debris racks might be a reasonable, temporary solution in special cases, if an existing culvert has a high risk of debris plugging and there is a clear responsibility and committed schedule for replacing the culvert. The debris rack for this situation should be mounted high on the culvert, above the ordinary high water mark. The space below it is left open for typical flows. The rack itself is only functional at high flows when debris is moving. Openings within the bar rack should be no smaller than nine inches. A specific monitoring and maintenance plan should be developed for any debris rack, and convenient access must be provided for these activities.

Ecological connectivity issues are difficult to quantify and generalize, but they may ultimately be significant to the health of aquatic ecosystems. More development of the concept of ecological connectivity in relation to road culverts is expected and encouraged.

Channel Maintenance

Other than fish passage, the need for channel maintenance created by poor siting of road crossings and culverts is the greatest impact culverts have on aquatic habitats. Highways are often placed at the fringe of river floodplains and must, therefore, cross the alluvial fans of small streams entering the floodplain. As each stream enters the relatively flat floodplain, a natural deposition zone is created, and the channel is prone to excursions and avulsions across its alluvial fan. Culverts placed in these locations tend to fill with bed material. To keep the culvert from plugging and the water overtopping the road, periodic (in some cases as frequently as annually) channel dredging becomes necessary. Bed-material removal is a major cause of channel instability and loss of spawning and rearing habitat for some distance upstream and downstream. It also has an ecological-connectivity impact by blocking bed material and the aggrading-channel process from migrating throughout the reach.

Mitigation for these channel-maintenance impacts includes installing a bridge or a culvert large enough that the aggradation and channel-evolution processes can continue. A bedload sump might be useful in some situations to localize the dredging needed at existing culverts and even eliminate the upstream impacts of dredging. (Information on the design of such sediment traps can be found in the upcoming Washington Department of Fish and Wildlife document, *Stream Habitat Restoration Guidelines.*) If relocating the road is possible, it is normally considered a superior alternative.

Construction Impacts

Construction impacts might include the release of sediment or pollutants, temporary fish-passage barrier during construction, removal of bankline vegetation, blocking of the flow or stranding of fish. Provisions in WAC 220-110-070 address these issues by way of construction timing, water-quality management, erosion- and sediment-control planning, and revegetation. Construction plans submitted for Hydraulic Project Approval should include, in addition to plans and specifications, an erosion- and sediment-control plan covering these items. The provisions of WAC 220-110-070 may be modified for specific projects.

Risk of Culvert Failure

Structural failure of culverts can cause long-term, extensive and massive damage to habitat. Failures can be a result of inadequate design, poor construction, beaver damming, deterioration of the structure or extreme natural events. Risk of failure can be minimized by sizing the culvert to accommodate extreme flow events and debris. This may include appropriate inlet and/or outlet armoring and the use of proper backfill and compaction techniques during construction.

In some cases, fords or alternative road overflow points may be useful. This should be considered along forest roads that are susceptible to debris flows or along roads that cross alluvial fans (for guidelines on ford design, contact WDFW for Technical Assistance).

Chapter 2 – Fish Barriers at Culverts

The parameters provided in WAC 220-110-070 serve as the technical definition of a fish-passage barrier and the basis for fish-passage design. Some level of barrier is assumed to be present when the criteria are not achieved. The regulation is included in Appendix B, *Washington Culvert Regulation*.

Barriers block the use of the upper watershed, which is often the most productive spawning habitat, considering channel size, substrate and available rearing habitats. Fish access to upper portions of the watershed is important; fry produced there then have access to the entire downstream watershed for rearing. *Complete* barriers block all fish migration at all flows. *Temporal* barriers block migration some of the time and result in loss of production by the delay they cause (anadromous salmonids survive only a limited amount of time in fresh water, and a delay can limit egg distribution or cause mortality). *Partial* barriers block smaller or weaker fish within a species and limit the genetic diversity that is essential for a robust population. Fish-passage criteria accommodate weaker individuals of target species including, in some cases, juvenile fish.

There are five common conditions at culverts that create migration barriers:

- excess drop at the culvert outlet,
- high velocity within the culvert barrel,
- inadequate depth within the culvert barrel,
- turbulence within the culvert, and
- debris and sediment accumulation at the culvert inlet or internally.

The interior surface of a culvert is usually designed to optimize water passage; it does not have the roughness and complexity needed to slow down the flow that a streambed does. Instead, the culvert concentrates and dissipates energy in the form of increased velocity, turbulence or downstream channel scour are the most prevalent blockages at culverts.

A culvert is a rigid boundary set into a dynamic stream environment. As the natural stream channel changes, especially with changes in hydrology due to land use changes, culverts often are not able to accommodate those changes. Instead, they become barriers to fish passage.

Fish-passage barriers at culverts can be the result of improper design or installation, or they may be the result of subsequent changes to the channel. Fish-passage barriers are very often the result of degrading channels, leaving the culvert perched above the downstream channel. Changes in hydrology due to urbanization are a common cause of channel degradation. Fish-passage barriers are also caused by scour-pool development at the culvert outlet. The scour pool may be good habitat in itself but it moves the backwater control of the downstream channel further downstream and creates a drop at the outlet. The presence of large scour pools at a culvert outlet and/or midchannel gravel bars upstream of the culvert are often indicators that a velocity barrier for fish exists inside the culvert at high flows.

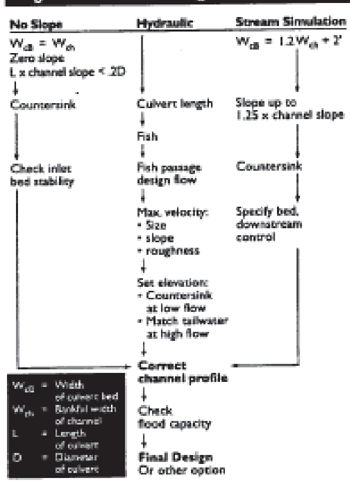
All fish-passage structures require some level of maintenance. Adult fish typically migrate during the high flow seasons and in response to freshets. Timely inspections and maintenance during inclement weather are necessary at all facilities. When culverts are not adequately inspected and maintained, fish-passage barriers can form. The maintenance done at a culvert for the purpose of high-flow capacity is often different than what is required for fish passage. For example, debris that is plugging slots in baffles for example may not affect the flow capacity of a culvert, but it may block fish from passing through. More than a cursory inspection of the culvert inlet and outlet is necessary for an adequate fish-passage maintenance program.

Many fish-passage barriers that occur at high stream flows are not apparent during low and normal stream flows. For a complete fish-passage assessment, culverts must be analyzed at both the low and high fish-passage design flows. Definition and selection of design flows are discussed in this guideline. The Washington Department of Fish and Wildlife has developed a spreadsheet to determine if a culvert meets the criteria in WAC 220-110-070. The spreadsheet can be found in the ***Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual***, published by the department and available at www.wa.gov/wdfw/hab/engineer/fishbarr.htm. The manual provides guidance on how to locate, assess and prioritize fish-passage problems (e.g., culverts, dams, fishways) and problems associated with surface-water diversion screens.

Chapter 3 – Culvert Design For Fish Passage

Many road crossings in Washington State have been designed or retrofitted to provide fish passage. The experience of observing and monitoring such sites, together with research on fish migration behaviors and swimming capabilities, has led to several straightforward design procedures outlined in this guideline. Chapter 1, *Habitat Issues at Road Crossings* described the first step in the design process, which involves becoming aware of the potential habitat issues that arise when roadways cross streams. Chapter 2, *Fish Barriers at Culverts*, identified some of the concerns to be addressed if culverts are to be used to convey a stream through a roadway crossing. This chapter and the rest of this guideline describe how to design a culvert to provide fish passage. A general flow chart of the culvert-design process for fish passage is shown in **Figure 3-1**.

Figure 3-1. Culvert Design for Fish Passage



A general flow chart of the culvert design process.

Design of Road Culverts for Fish Passage provides specific guidance to satisfy state regulations and to cover additional situations that exceed those defined by regulations. The criteria provided here are not absolute; however, if they cannot be achieved for a specific project, then other road-crossing means should be considered instead. Such options may include installing a temporary culvert, rerouting the road to eliminate the stream crossing or constructing a bridge. Variances to some design criteria can be approved if adequate justification is provided.

Recent experience in western Washington has shown that about 25 percent of fish-passage barriers at culverts have required full replacement of the culvert. Some of these replacements have been accomplished by boring new culverts through high road fills. About five percent have required replacement of the culvert with a bridge or abandonment of the roadway. These percentages will likely change as more culvert barriers are fixed in low-gradient areas and projects move upstream to higher-gradient reaches.

When culverts are the solution of choice, effective fish passage can often be provided through the proper determination of culvert slope, size, elevation and roughness. Constructing formal structures and allowing the upstream channel to regrade to a steeper gradient can also be useful. Fish-passage construction at low-gradient sites can usually be limited to within 100 feet or less of the channel length outside the culvert; construction at steeper sites may extend further upstream and downstream from the culvert, or it may require formal fish ladders or full culvert removal.

The determination of adequate fish passage at a culvert is based on criteria described in WAC 220-110-070. This regulation describes two different approaches for ensuring fish passage:

1. the No-Slope Design Option, and

2. the Hydraulic Design Option.

A third option is also acceptable; it is the Stream-Simulation Design Option, in which an artificial stream channel is constructed inside the culvert.

The No-Slope Design Option results in reasonably sized culverts without requiring much in the way of calculations. The *Hydraulic Design Option* requires hydrologic and open-channel hydraulic calculations, but it usually results in smaller culverts being required than the No-Slope Design Option. (Smaller culverts may trap more debris; however, so a factor of safety must be applied.) The Hydraulic Design Option is based on velocity, depth and maximum-turbulence requirements for a target species and age class. The *Stream-Simulation Design Option* involves constructing an artificial stream channel inside the culvert, thereby providing passage for any fish that would be migrating through the reach.

It is difficult in most situations, if not impossible, to comply with velocity criteria for juvenile fish passage using the Hydraulic Design Option. The No-Slope and Stream-Simulation Design options, on the other hand, are assumed to be satisfactory for adult and juvenile passage; thus, they tend to be used more frequently at sites where juvenile fish passage is required. Application of the No-Slope Design Option is most effective for relatively short culverts at low-gradient sites.

Road-Crossing Siting

Fish-passage barriers and the cumulative habitat loss caused by culverts can be reduced in part by properly citing the culvert and by minimizing the number of road crossings. Both the siting of culverts and the land-use planning that creates the need for the culverts are important.

Culvert Siting

The goal in siting a culvert is to make the culvert as short as possible without deviating from the direction of the upstream and downstream channel course by more than 30 degrees. A culvert that mimics the exact course of a stream may be long enough to become a fish-passage barrier. On the other hand, a culvert made shorter by deviating the course of the stream at an extreme angle (greater than 30 degrees to the channel) will reduce the success of fish passage by increasing inlet contraction and turbulence at high flows. Increased contraction also makes the culvert less efficient for flood capacity and sediment transport. In-channel deposition and bank scour often occur upstream of culverts with excess skew. When the culvert is skewed relative to the downstream channel and the culvert outlet is not directed at the channel alignment, there is an increased risk of bank erosion.

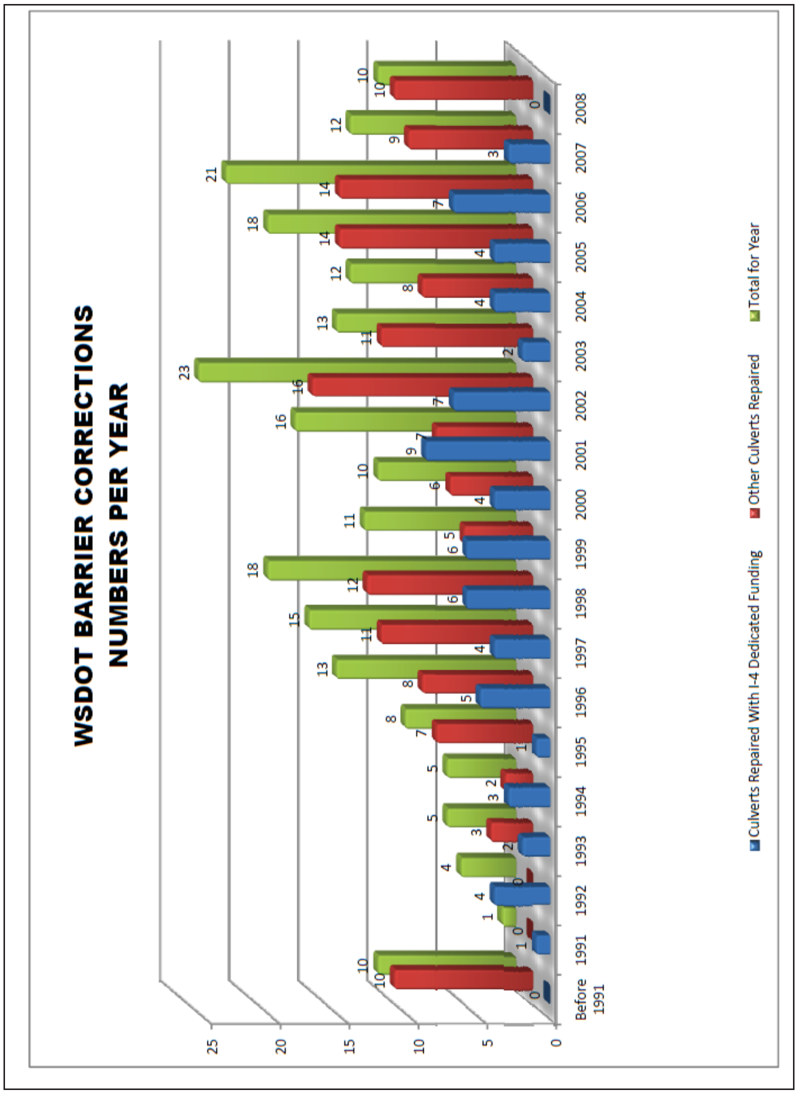
It's also important to anticipate potential natural lateral migration or vertical changes of the channel when siting a culvert. The installation of a culvert fixes a section of the channel rigidly in place. If a stream is naturally unstable and/or is migrating across a floodplain, the rigidity of the culvert may exacerbate the stream's instability, accelerate the stream's migration rate or make the stream's migration become more pronounced and chaotic. Channels naturally move vertically over time. Instabilities may occur in which the channel bed continues to aggrade (rise) or degrade (incise) over long periods of time. A channel may also fluctuate in elevation in response to floods. Long-term or short-term channel changes must be accommodated in culvert design. If they can't be accommodated, other solutions, such as a bridge or an alternative road alignment, may be more appropriate.

Land-Use Planning

Many new stream crossings can be avoided (or at least the number required can be reduced) through proper land-use planning. Even the best of fish-passage design has the potential to become a fish-passage barrier. The way local jurisdictions prepare and implement land-use plans and critical-areas ordinances has a direct influence on fish-passage success by distributing land uses and the transportation systems necessary to support them. For example, if a county fails to allocate forest or agricultural land, applying instead a very dense pattern of urban, suburban or rural residential land uses, one can expect many stream crossings to be required. This would not be the case if less dense and intense land uses, such as forestry or agriculture, were coupled with a combination of compact, urban growth areas and large, rural parcels.

In addition to the number of road crossings, changes in hydrology and riparian areas due to dense urbanization also affect fish passage. These changes cause channel incision and channel simplification that often leave culverts perched above the downstream channel, forming barriers to fish migration. Other likely impacts are sediment and temperature impacts. With these changes, the only adequate habitat left is confined to areas upstream of the urbanization, making downstream fish-passage barriers even more damaging to fish production.

Fish passage is not the only habitat concern created by the improper design of fish culverts. These concerns are described in detail in Chapter 1.


WSDOT BARRIER CORRECTIONS
NUMBERS PER YEAR
0
5
10
15
20
25
Before 1991
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Culverts Repaired With I-4 Dedicated Funding
Other Culverts Repaired
Total for Year

Road	MP	Site Id	Stream	Trib To	Priority Index (PI)	Habitat Gain (meters)
SR 5	255.15	991036	Squalicum Cr	Bellingham Bay	58.2	34,827
SR 8	6.3	990133	Wildcat Cr		52.7	21,924
US 2	23.07	07.0939 0.40	Wagleys Cr	Skykomish R	50.82	15,105
SR 3	40.95	15.02291.010	Chico Cr	Dyes Inlet	48	35,048
SR 202	0.1	102 L062	Little Bear Cr	Sammamish R	42.1	29,619
SR 16	28.1	990017	Anderson Cr	Sinclair Inlet	38.6	9,295
SR 16	28.1	996753	Anderson Cr	Sinclair Inlet	32.33	9,295
SR 96	0.47	102 N183	North Cr	Sammamish R	32.09	3,976
SR 101	267.16	990219	Johnson Cr		31.46	7,252
SR 548	4.7	990429	Terrell Cr	Birch Bay	31.43	11,313
SR 305	2.44	994325	Unnamed	Murdon Cove	29.44	2,358
SR 307	0.49	990123	Dogfish Cr	Liberty Bay	27.97	7,891
SR 503	15.84	991656	Rock Creek		27.45	13,644
SR 6	5.37	990805	Unnamed	Willapa River	25.91	3,511
SR 101	102.14	990032	Unnamed	SB Big Cr	25.82	7,870
SR 101	146.05	990178	Harlow Cr	Queets River	25.68	5,525
SR 162	11.04	105 R021121a	Card Cr	Carbon R.	23.48	2,908
SR 11	20.25	994389	Padden Cr	Bellingham Bay	22.72	4,213
SR 112	57.61	990092	Colville Cr		22.03	15,710
SR 99	54.24	102 N192	North Cr	Sammamish R	21.31	518
SR 307	1.34	991999	Unnamed	Dogfish Cr	20.92	3,372
SR 101	61.15	990053	Butte Cr	Smith Cr	20.66	2,800
SR 8	9.1	990773	Unnamed	Mox Chehalis	20.63	2,481
SR 5	58.63	990152	Foster Cr	Cowlitz River	20.55	6,939
SR 112	47.1	990304	Nelson Cr		20.42	4,684
SR 112	25.6	991730	Unnamed	Physt	20.31	3,347
SR 101	303.01	994484	Marple Cr	Hood Canal	20.05	2,755
SR 12	9.04	994791	Unnamed	Wynoochee R	19.5	2,649
SR 101	90.73	993679	Unnamed	Hoquiam R	19.5	323
SR 112	33.21	990214	Joe Cr		19.37	7,158
SR 503	13.25	991657	Unnamed	Rock Cr	18.88	3,325
SR 101	100.9	990729	Unnamed	SB Big Cr	17.97	1,202
SR 542	38.98	990606	Chainup Cr	NF Nooksack R	17.41	306
SR 503	25.36	990073	Chelatchie Cr		16.8	2,032
SR 307	1.45	991572	Unnamed	Dogfish Cr	16.41	1,024
SR 12	95.75	990190	Highland Cr	Tilton River	16.12	5,980
SR 112	29.12	991732	Indian Cr		15.98	2,567
SR 530	42.9	990151	Fortson Cr	NF Stillaguamish R	15.37	1,030
SR 503	33.04	994531	Brooks Cr		15.28	2,072
SR 7	5.5	990831	Unnamed	Tilton River	15.13	784
SR 109	33.1	991272	Wayne	Pacific Ocean	14.45	3,972
SR 19	4.3	990711	Swansonville Cr	EF Chimacum Cr	14.11	3,178
SR 101	209.32	990554	Wisen Cr		13.7	3,273
SR 9	67.33	991448	NP Cr	Samish R	12.68	2,101
SR 109	36.43	991270	Unnamed	Pacific Ocean	12.18	3,081
SR 112	52.9	991660	Nordstrom Cr		11.46	4,855
SR 7	41.17	990297	Muck Creek		24.61	8,388
TOTAL						

WRIA	Proposed Solution	Estimated Cost	Region
1	Replace with 25' stream simulation culvert	$8,341,855	NW
22	Retrofit of existing 20'Wx8'H box culvert	$268,100	Oly
7	Remove flume structure under bridge & reconstruct stream channel	$750,000	NW
15	Replace culverts with 4 bridges	$29,700,000	Oly
8	130' long x 42' wide by 12' tall culvert	$4,967,075	NW
15	20' wide stream simulation design (two pipes that will become one)	$6,443,544	Oly
15	see above	see above	Oly
8	Replace culvert with 11' culvert	$1,492,000	NW
19	Repair downstream rock weir w/ roughened channel	$173,000	Oly
1	Replace 6' round culvert with 24' wide stream simulation culvert	$3,837,028	NW
15	Replace 5'x4' culvert with 14' wide no slope	$2,948,000	Oly
15	Replace 4' culvert with 15'x10' no slope culvert	$2,231,700	Oly
27	24'Wx12"hx110'L no slope design	$1,338,346	SW
24	14'W stream simulation design	$960,000	SW
22	Replace with a stream simulation design	$1,236,000	Oly
21	Replace box culvert with a bridge	$5,193,118	Oly
10	Replace 3'x2' culvert with	$1,500,000	Oly
1	Convert 2,310' pipe to storm sewer and build new creek channel	$5,500,000	NW
19	Replace two 4' culverts with a 24' stream sim culvert	$2,621,354	Oly
8	Replace 2.5' pipe with a 12' stream sim culvert	$2,314,000	NW
15	Replace 4' culvert with 15'x10' stream sim design	$2,440,228	Oly
24	14'W stream simulation design	$690,495	SW
22	Retrofit of existing 4'Wx4'H box culvert	$143,100	Oly
26	Retrofit of existing 9'x9' box with 6 downstream grade controls	$363,808	SW
19	15' wide stream simulation	$1,338,400	Oly
19	12' wide stream simulation	$836,709	Oly
17	140' bridge	$4,497,000	Oly
22	12' diameter round no slope culvert	$1,048,000	Oly
22	8' round stream simulation	$974,300	Oly
19	20' wide stream simulation	$1,655,000	Oly
27	20'Wx20'Hx110'L stream simulation	$1,674,000	SW
22	10' wide stream simulation	$931,044	Oly
1	30' span bridge	$866,654	NW
27	12'Wx8'H no slope design	$655,508	SW
15	Replace with 13' stream simulation culvert	$2,726,000	Oly
25	16' W x 90' L stream simulation design	$748,326	SW
19	Replace 2' culvert with 12' stream sim and removes hairpin curve	$2,843,225	Oly
5	15'W x 12'H stream simulation culvert w/ grade controls	$2,528,424	NW
27	22'Wx120'L stream simulation design	$1,366,464	SW
26	40' W x 116' L bridge	$2,424,723	SW
21	Replace culvert with 200' bridge	$4,092,096	Oly
17	Replace 2' culvert with 10' stream sim design	$1,215,169	Oly
19	Replace 5' culvert with 17' stream sim design	$1,670,885	Oly
3	Replacement with a 12' stream simulation box	$1,104,502	NW
21	Replace fishway with 60' to 80' bridge	$2,306,250	Oly
19	Replace 5' culvert with 16' stream sim design	$2,382,457	Oly
11	Replace double box culvert with 22' wide stream simulation culvert	$1,729,600	Oly
		$127,067,487	

THE HONORABLE RICARDO S. MARTINEZ

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT SEATTLE

UNITED STATES OF AMERICA, et al., Plaintiff, vs. STATE OF WASHINGTON, et al., Defendant.	No. C70-9213 Subproceeding 01-1 DECLARATION OF LAWRENCE JAY WASSERMAN

I, LAWRENCE WASSERMAN, declare as follows:

1. I am over the age of eighteen and am competent to testify on the matters set forth herein. I make this declaration and the report attached hereto on the basis of my personal knowledge, skill, experience, training and education.

2. I received a Bachelor of Arts degree in Biology from the State University of New York at Buffalo in 1976 and a Master of Science Degree in Fisheries from the University of Washington in 1984. My thesis for my master's degree is entitled "The Rearing Potential for Coho Salmon (Oncorhynchus kisutch) in Streams Affected by the Eruption of Mount St. Helens."

3. I have authored or co-authored the following scientific papers:

Cause No. C70-9213, Sub. 01-1
Plaintiffs' Exhibit **AT-010**

SWINOMISH INDIAN TRIBAL COMMUNITY
OFFICE OF TRIBAL ATTORNEY
11404 MOORAGE WAY
LA CONNER, WA 98257
PH: (360) 466-3163, FAX: (360) 466-5309

a. Wasserman, Lawrence Jay, 1984. "The Rearing Potential for Coho Salmon (Oncorhynchus kisutch) in Streams Affected by the Eruption of Mount St. Helens. M.S. Thesis. Univ. of Washington." 108 pp.;

b. Wasserman, Lawrence J., Carl J. Cederholm, and Ernest O. Salo. 1984. "The Impact of Logging on Benthic Community Structure in Selected Watersheds of the Olympic Peninsula, Washington." Univ. of Washington. Tech. Rep. FRI-UW-8403;

c. Wasserman, Larry; Joel Hubble, Bruce Watson, Yakima Indian Nation, Fisheries Resource Management, Tom Vogel, Project Manager, U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife, Contract No. DE-AI79-1983BP39461, Project No. 1982-16, 131 electronic pages (BPA Report DOE/BP-39461-1)

d. Bilby, R.E. and L. Wasserman. 1989. "Forest practices and riparian management in Washington State: data based regulation development." in Practical Approaches to Riparian Resource Management: an Educational Workshop, May 8-11, 1989, R.E. Gresswell; B.A. Barton and J. L. Kershner, editors. U.S. Bureau of Land Management, Billings, Mont., pp. 87-94;

e. Martin, D.J., L.J. Wasserman, and V. Dale. 1986. "Influence of Riparian Vegetation on Post-eruption Survival of Coho Salmon Fingerlings on the West-Side Streams of Mount St. Helens, Washington." North Amer. J. Fish. Mgmt. 6:1-8;

f. Martin, Douglas J., Lawrence Wasserman, Robert P. Jones, and Ernest O. Salo. 1984. "Effects of Mount St. Helens' Eruption on Salmon Populations and Habitat in the Toutle River." Office of Water Research and Technology., Washington Water Research Center. Tech. Comp. Rep. 130 pages;

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g. Beechie, T., Beamer E. and Wasserman, L. 1994. "Estimating Coho Rearing Habitat and Smolt Production Losses to develop a Restoration Strategy for a Large River Basin," N. Amer. J. Fish. Mgmt. 14:797-811;

h. Hollowed, John J. and Wasserman, L. 1999. "A Critique of the State's Hydraulic Code, RCW 75.20," Center for Natural Resource Policy Report; and

i. Hollowed, John J. and Wasserman, L. 2001. "A Critique of the Washington States' Instream Resource Protection Laws and Regulations," Center for Natural Resource Policy Report.

4. The aforementioned paper entitled by "Estimating Coho Rearing Habitat and Smolt Production Losses to develop a Restoration Strategy for a Large River Basin" authored by myself and two of my colleagues at the Skagit System Cooperative was awarded a citation by the American Fisheries Society for the Most Significant Paper in the North American Journal of Fisheries Management for 1994.

5. Between 1983-1986 I was employed as Environmental Services Director by the Yakama Nation as a researcher and project manager. Among my duties, I investigated the potential for restoring Chinook salmon populations through the use of hatchery supplementation. I also investigated the movement of juvenile Spring Chinook throughout the Yakima River. I was involved with the design and operation of a large smolt trap on the Yakima River.

From 1986 to 1991, I continued in my role as Environmental Services Director, but my duties changed. In this period of time, I oversaw environmental protection of fisheries resources for the Yakama Nation. My area of responsibility included the Columbia River Watershed and its tributaries above Bonneville Dam within Washington State. My responsibilities included, but were not limited to: (a) reviewing and commenting on forest practices applications, water rights applications, permits for on and off reservation timber sales; (b) reviewing and commenting on local, State and Federal legislation; (c) reviewing, commenting and negotiating, where necessary, hydraulic project approvals, and general land use permits issued by municipal, County, State and Federal agencies. In this capacity, I was responsible for providing technical recommendations to the Yakama Tribal Council regarding the impact such activities might have on fisheries resources and what action the Yakama Nation could take to protect such resources. Additionally, I was tasked with locating blocking culverts on the Yakama Indian Reservation.

During this time I was involved as a negotiator in the Timber, Fish and Wildlife Agreement, which was a negotiated agreement between the State of Washington, the Washington Forest Practices Association, Washington Farm Forestry Association, , Washington State Indian Tribes, and several environmental organizations. This agreement resulted in increased protection for fisheries resources affected by Washington State's Forest Practices rules. I was also involved in the establishment of the Hanford Reach National Monument on the Columbia River, which provided permanent protection for the last free flowing section of the Columbia River.

6. From 1991 until 2007 I was employed as Environmental Services Director by the Skagit System Cooperative ("SSC"), which represented the fisheries interests of the Sauk-Suiattle Indian Tribe, the Upper Skagit Indian Tribe and the Swinomish Indian Tribal Community. SSC changed its name to the Skagit River System Cooperative ("SRSC") in 2004 when the Upper Skagit Indian Tribe withdrew from the consortium. My work for both SSC and SRSC entailed

advocating for the protection of natural resources and specifically for the protection and restoration of fisheries throughout the Tribes' usual and accustomed fishing areas. However, the area of greatest emphasis was the Skagit River watershed, which is the third largest river in the western United States and contains wild populations of all six species of Pacific salmon. A portion of my work was dedicated to reviewing the scientific literature and analyzing Skagit Basin specific field data addressing the impacts of land use practices on salmon habitat and the use of that data in developing strategies for the protection of Tribal resources. I have been involved with drafting regulations regarding watershed analysis pursuant to the Washington State Forest Practices Act, and have served as a member of tribal negotiating teams involved in State-wide negotiations associated with instream flows, forest practices, and agricultural practices. Much of my work has been focused on developing mechanisms to protect Tribal natural resources. These fora have included discussions and negotiations with elected leaders at the local, State and Federal levels, with local and statewide business, recreational, and environmental interests, and with other Tribes and Tribal organizations. This work includes the development of management strategies to protect and restore Tribal resources through collaborative as well as legal means.

7. In 2007 I began employment at the Swinomish Indian Tribal Community as Environmental Policy Manager. My duties and responsibilities are the same as those previously provided to the Sauk-Suiattle Indian and Swinomish Tribes while I was employed by Skagit River System Cooperative as Environmental Services Director.

8. Over the last twenty-five years, I have kept current on the literature associated with the Pacific salmon life histories and habitat management. In addition to the work identified above, I

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11404 MOORAGE WAY
LA CONNER, WA 98257
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have undertaken scientific analyses regarding riparian vegetation management and the setting of instream flow levels for salmon by the State of Washington.

9. For at least twenty years, I have been a member of the American Fisheries Society and am past Secretary-Treasurer of the North Pacific International Chapter of the American Fisheries Society and served for 2 years. I was formerly a member of the North American Benthological Society.

10. I am currently Vice-President of a non-profit organization called the Center for Natural Resource Policy, which provides Native American tribes and members of the public with policy, legal, and scientific support on fisheries and other natural resource issues.

11. From 1997-2008 I was Vice-Chair of the Skagit Watershed Council, a watershed based non-profit organization made up of multiple stakeholders. The mission of the Council is to promote voluntary salmon restoration projects within the Skagit River watershed. We developed a restoration strategy for the recovery of salmon in the Skagit River as well as criteria by which the Watershed Council would evaluate restoration projects for submittal to funding agencies.

12. Attached hereto and incorporated by reference is a true and complete copy of a report that I prepared at the request of counsel for the Plaintiff-Intervenor Tribes in this case. The report describes basic life history strategies and requirements of salmon and steelhead that occur within the *United States v. Washington* Case area.[1] It contains four parts: first, I describe in

1 I use the term "case area" as it was defined by Judge Boldt in *United States v. Washington*, 384 F.Supp. 312, 327 (W.D. WA. 1974), namely, "that portion of the State of Washington west of the Cascade Mountains and north of the Columbia River drainage area, and includes the American portion of the Puget Sound watershed, the watersheds of the Olympic Peninsula north of the Grays Harbor watershed, and the offshore waters adjacent to those areas."

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PH: (360) 466-3163, FAX: (360) 466-5309

general terms life history characteristics and essential habitat components common to all salmon. Second, I discuss species specific life history strategies and factors influencing salmon survival. Third, I describe the impacts of culverts that impede fish passage and/or result in adverse environmental impacts to salmon habitat and why repairing culverts make sense financially, socially, and biologically. Fourth and finally, I describe Tribal efforts to protect and restore salmon populations, including efforts to repair culverts. For the purposes of this declaration and report, Pacific salmon and steehead will be referred to as salmon throughout the document unless otherwise noted.

13. In preparing my report, I have generally relied upon the Joint Statement Regarding the Biology, Status, Management and Harvest of the Salmon and Steelhead Resources of the Puget Sound and Olympic Peninsular Drainage areas of Western Washington (hereinafter Joint Biological Statement) prepared in 1973 for use by the Washington Department of Fisheries, Washington Department of Game, and the U.S. Fish and Wildlife Service for this case and was admitted into evidence as JX-2a[2] as well as a more current and extensive treatise on Pacific salmon by Groot, C., and L. Margolis entitled Pacific Salmon Life Histories (University of British Columbia Press, Vancouver, British Columbia, 1991). The latter treatise is recognized as a reliable authority by experts in the field of fisheries for the propositions set forth in my report.

14. Figure 5.1 is a true and correct copy from Beamer, et al. (1998). This figure demonstrates graphically the relationship between density of salmon and salmon production:

2 *United States v. Washington*, 384 F.Supp. at 328.

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I am familiar with this relatiionship and the Beaverton-Holt stock recruitment curves. I can attest that the graph in Figure 5.1 accurately demonstrates this relationship in the Skagit watershed. The data shown in this figure are considered reliable by scientists in my field of expertise

15. Figure 4.1 is a true and correct copy from the Skagit Chinook Recovery Plan, Appendix D prepared by the Skagit River System Cooperative and Washington Department of Fish and Wildlife (WDFW) in 2005. This figure demonstrates graphically the concept of density dependence and density dependence mortality in the Skagit watershed. I am familiar with both of these two concepts in a general manner and as they pertain to the Skagit watershed. I can attest that the graphs in Figure 4.1 accurately demonstrate these two concepts in the Skagit watershed. The data shown in this figure are considered reliable by scientists in my field of expertise.

16 Attachment A is a true and correct copy of an illustration entitled Pacific Salmon lifecycle prepared by the Washington Department of Fish and Wildlife. It illustrates the general life history strategies of anadromous salmonids. As a fisheries biologist, I am familiar with these life history strategies. and can attest that the picture in Figure 1 accurately explains those strategies for Pacific salmon. The data shown in this figure are considered reliable by scientists in my field of expertise.

17. Attachment B is a true and correct copy of pages 17-20 of the Joint Statement Regarding the Biology, Status, Management and Harvest of the Salmon and Steelhead Resources of the Puget Sound and Olympic Peninsular Drainage areas of Western Washington prepared in 1973

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11404 MOORAGE WAY
LA CONNER, WA 98257
PH: (360) 466-3163, FAX: (360) 466-5309

for use by the Washington Department of Fisheries, Washington Department of Game, and the U.S. Fish and Wildlife Service for this case and admitted into evidence as JX-2a.

18. Attachment C is a true and correct copy of pages 7-13 from the Washington Department of Fish and Wildlife's Manual entitled *Design of Road Culverts for Fish Passage* (2003). These pages discuss impacts associated with culverts. As a fisheries biologist, I am familiar with biological life histories of salmon and how those life histories are impacted by fish passage barriers, specifically culverts. These pages from WDFW's Manual accurately explain those impacts and would be considered to reliably depict those impacts by scientists in my field of expertise.

19. Attachment D is a true and correct copy of a photograph that I took on a digital Pentax Optio W20 camera on 9/1/2006 (8/30/2006). It shows a culvert on an unnamed tributary to the Nooksack River (Site No.T39R05E-27) that will not allow for upstream passage of either adult or juvenile salmon because the distance between the water surface elevation and the bottom of the culvert is too great for the fish to ascend. The photograph accurately portrays the scene which I personally witnessed.

20. Attachment E is a true and correct copy of a photograph that I took on a digital Pentax Optio W20 camera on 9/1/2006. It shows elimination of rearing habitat within a culvert adjacent to Site No.T39R-05-27 on DNR S1100. The photograph accurately portrays the scene which I personally witnessed.

21. Attachment F is a true and correct copy of a photograph that I took on a digital Pentax Optio W20 camera on 9/01/2006. It shows an unnamed tributary to the Nookack River, shows a

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culvert with adequate substrate within the culvert Site No. T39R06E-119. The photograph accurately portrays the scene which I personally witnessed.

22. Attachment G is a true and correct copy of a photograph taken by Kurt Buchanan, a fisheries biologist at the Washington Department of Fish and Wildlife on 12/9/2004. It shows the culvert at Red Cabin Creek (Site No.AR11) in December 2004 in the Skagit Basin under State Route 20 filled with sediment prior to dredging by the Washington Department of Transportation (with his handwritten notes excised). The photograph was provided to the Skagit River System Cooperative by Mr. Buchanan as part of our work on culverts and Red Cabin Creek in particular. I routinely receive and rely on photographs of this type in performing my professional duties as a fisheries biologist. The photograph accurately portrays scenes which I have personally witnessed at Red Cabin Creek in 2006, 2008 and 2009.

23. Attachment H is a true and correct copy of a photograph that I took on a HTC TouchPro Cellphone camera on February 20, 2009. It shows the same culvert at Red Cabin Creek (Site No.AR11) filled with sediment. The photograph accurately portrays the scene which I personally witnessed.

24. Attachment I is a true and correct copy of a photograph that I took on a HTC TouchPro Cellphone camera on February 20, 2009. It shows the blockage at the downstream end of the same culvert (Site No.AR11) in Red Cabin Creek. The photograph accurately portrays the scene which I personally witnessed.

25. Attachment K is a true and correct copy of a photograph that I took on a digital Pentax Optio W20 camera on 8/30/2006. It shows the culvert at Red Cabin Creek (Site No. AR11)

after the streambed had been dredged. The photograph accurately portrays the scene which I personally witnessed.

26. Attachments K and L are true and correct copies of two photographs that Keith Wyman, a former employee at Skagit River System Cooperative, took on 12/2/2002 and 12/9/2004 respectively. Attachment J shows a number of dead unspawned coho salmon stranded as a result of Washington State Department of Transportation (WSDOT) dredging activities at the same culvert (Site No.AR11) on Red Cabin Creek. Attachment K shows numerous adult and juvenile salmon that have been stranded (and subsequently died) as a result of the WSDOT maintenance activities at the same culvert (Site No.AR11) on Red Cabin Creek. Both photographs were taken by Mr. Wyman while employed at the Cooperative and provided to me as part of my daily work at the Cooperative. I routinely receive and rely on photographs of this type in performing my professional duties as a fisheries biologist. Both photographs were also provided to Kurt Buchanan of WDFW and appear in the Email referenced as Attachment M below.

27. Attachment M is a true and correct copy of an Email from Kurt Buchanan of WDFW to Greg Hueckel and Pat Chapman, with copies to Bob Bicknell, Craig Olds, Gayle Kreitman, Rich Costello, and Rich Johnson dated 12/6/2004 with his attached notes of his observations of the sediment blockage of the culvert at Red Cabin Creek (Site No. AR11). The Email and notes with photographs were provided to the Skagit River System Cooperative as part of my and the Cooperative's work on culverts and Red Cabin Creek in particular. I routinely receive and rely on Emails and reports of this type in performing my professional duties as a fisheries biologist..

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28. Attachment N is a true and correct copy of a Hydraulic Project Approval (HPA) dated August 19, 2002 (Log # ST-F0760-03) issued by WDFW to WSDOT for maintenance at Red Cabin Creek (Site No. AR11). The HPA was provided to Skagit River System Cooperative by Kurt Buchanan of WDFW as part of my and the Cooperative's work on culverts and Red Cabin Creek in particular. I routinely receive and rely on HPAs in performing my professional duties as a fisheries biologist.. The HPA is also a matter of public record.

29. Attachment O is a true and correct copy of a photograph that I took on a digital Pentax Optio W20 camera on 12/07/2006. It shows a culvert (Site No. 9900046) on Bruce Creek in the Nooksack Drainage filled with sediment. The photograph accurately portrays the scene which I personally witnessed.

30. Attachment P is a true and correct copy of a photograph that I took on a digital Pentax Optio W20 camera on 9/1/2006. It shows a culvert (Site No. 9900046) on Bruce Creek in the Nooksack Drainage after sediment has been removed by dredging. The photograph accurately portrays the scene which I personally witnessed.

31. Attachment Q is a true and correct copy of a photograph that I took on a digital Pentax Optio W20 camera on 9/1/2006. It shows a beaver dam constructed on culvert (Site No. 01.03530) on Bear Creek in the Nooksack watershed filled with sediment. The photograph accurately portrays the scene which I personally witnessed.

I declare under penalty of perjury that the foregoing is true and correct.

EXECUTED on this 30th day of March, 2009 on the Swinomish Indian Reservation near the

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LA CONNER, WA 98257
PH: (360) 466-3163, FAX: (360) 466-5309

town of LaConner, Washington.

LAWRENCE JAY WASSERMAN
Environmental Services Manager
Swinomish Indian Tribal Community

United States v. Washington
United States District Court
Western District of Washington
Case No. C70-9213, Subproceeding 01-1

Written Direct Testimony Of Lawrence Jay Wasserman
Environmental Policy Manager
Swinomish Indian Tribal Community

Witness For Plaintiff-Intervenor Tribes

Testimony Prepared March 27, 2009

A. Salmon need unobstructed passage to their spawning and rearing areas.

Each species and population of salmon has preferred geographic areas and gravel characteristics that they seek out prior to spawning. Since salmon do not feed in fresh water, each species and population must reach its preferred spawning areas in a timely fashion so that its limited energy reserves are not depleted prior to spawning. Suitable spawning gravels are not evenly distributed throughout river and tributary systems, and natal streams may be located considerable distances from the mouth of river systems. Spawning salmon therefore need access to reach site specific spawning grounds in order to successfully spawn and produce offspring which will form the basis of the next cycle of returning adults.

Juvenile salmon also move considerable distance both upstream and downstream for a number of reasons. Their life history requirements are such that they need to find the appropriate depths, velocities and substrates in which to thrive in order to maximize food intake and minimize the expenditure of energy while swimming. Too many fish in one area may overwhelm the available food supply resulting in reduced growth rates of juvenile fish. The ability to migrate throughout streams provides individuals an opportunity to find lower density areas where food supplies may be more plentiful. Survival of juvenile fish is greatly influenced by body size, which in term is related to this balance between energy expenditures and availability of food supply.

Juvenile salmon need to find refuge areas to avoid predation, and to escape from high velocity streamflows during flooding or high temperatures that can be life threatening.

Adequate access to all parts of a watershed is necessary for dispersal of juvenile salmon populations. Salmon fry redistribute themselves to low velocity areas, such as side channels and slough areas after emergence. This redistribution is important to that young fish can colonize all accessible parts of the watershed, thereby reducing density dependent mortality. Both juvenile steelhead and coho salmon swim downstream from their natal streams during the summer months, and then upstream either in their home tributary or in other tributaries with the onset of fall rains. (Cederholm and Scarlett, 1981). Unimpeded passage provides the opportunity for juvenile salmon to access these important areas.

Finally, salmon need unimpeded access to the sea as smolts. Juvenile salmon generally move as smolts to the sea in late winter or spring, when stream flows are conducive to rapid downstream migration. If downstream passage is impeded so that fish cannot access the sea, the critical component of ocean residency is lost, with a resultant loss of production of fish from within the watershed.

B. Salmon require an adequate supply of cool water.

Access to stream segments with appropriate water temperatures is an important component of insuring that life history requirements at each life state are met. Salmon extract oxygen from water and the amount of oxygen in the water is dependant on a variety of factors including temperature. Lower streamflows in summertime coupled

E. Chum Salmon

Chum salmon generally return to Washington streams from September through December after spending two (2) to five (5) years at sea. Peak spawning occurs in late November through December, with reports of spawning occurring as late as March in the Nisqually River. (Joint Biological Statement, p. 6). Spawning areas occur near tidewater in the coastal streams of the Olympic Peninsula, while in Puget Sound, spawning tends to occur in the lower gradient portions of rivers and streams, and in backwaters, side channels and ponds with areas of upwelling. Chum salmon fry begin to move downstream soon after emergence, but in contrast to pink salmon, they spend a few days to weeks in estuarine areas prior to entering marine waters.

F. Steelhead

Steelhead tend to spend two (2) to four (4) years at sea before returning to spawn. There are two broadly defined runs of steelhead in Puget Sound: winter run and summer run. Summer run steelhead tend to enter rivers from June through October, while winter run steelhead enter from November through May. Peak spawning occurs in April and May. Steelhead spawn in large rivers and in both small and large tributaries. Juvenile steelhead are found throughout the upper reaches of small tributaries as far upstream as is accessible. They spend one to two years in freshwater prior to seaward migration. As with coho and spring chinook, juvenile steelhead require an adequate supply of high quality habitat during their extended freshwater residence time.

IV. FRESHWATER FACTORS INFLUENCING SURVIVAL AND MORTALITY OF SALMON

A. Overview of Density Dependent Mortality.

The number of adult fish produced within a watershed is a product of the quality and quantity of available habitat coupled with the number of eggs produced by the adults that return to spawn The number of fish available to be harvested or to spawn depends upon several factors: (1) how many of the eggs deposited in the gravel survive; (2) how many fish that emerge from the gravel to migrate to sea; (3) how many adult fish survive in the ocean; and (4) how many adults make it back to their spawning grounds. These factors are affected by annual variations in environmental conditions and the quantity and quality of accessible habitat to support incubating eggs, rearing juvenile salmonids, as well as by marine conditions and harvest rates.

Beamer, *et al.* (1998) provide a description of the relationship between density of salmon and salmon production:

> The processes regulating recruitment at small stock sizes are thought to be density-independent, whereas the processes regulating recruitment at large stock sizes are thought to be density-dependent. The relationship over a range of stock sizes is illustrated as some form of curve, such as the dome-shaped Ricker relationship or the asymptotic Beverton-Holt relationship. The asymptotic Beverton-Holt relationship is often used to characterize

salmonids with extended freshwater life histories, such as coho and steelhead (Lestelle et al. 1993b). The equation:

$$R = \frac{S}{bS + a}$$

is used to describe this relationship, where R is the number of smolts and S is the number of female spawners. Density-independent survival *(l/a)* is smolts per female spawner at the theoretical "zero" spawner density, and smolt carrying capacity is *1/b*. The coefficients *a* and *b*, which describe the shape of the Beverton-Holt curve, may be interpreted (at least in part) as being related to habitat characteristics (Moussalli and Hilborn 1986). The parameter *a* is perhaps most closely related to habitat ***quality*** while the parameter *b* is more closely related to habitat ***quantity*** (Lestelle et al. 1993b).

When habitat quality or quantity increase, *1/a* or *1/b* increase respectively. When "new" habitat area is made available to a fish stock by building a fish passage project (i.e., *1/b* is increased), we expect to see a locally larger parent stock, and subsequently greater recruitment. Curves A and B in Figure 5-1 illustrate two cases where the habitat capacities are different, but density independent survival is the same. Curve A represents the stock-recruitment curve for a hypothetical coho stream with a carrying capacity *(1/b)* of 10,000 smolts and a density-independent survival rate *(1/a)* of 134 smolts per female spawner.[12] Curve B represents the same stream, except carrying capacity has been doubled by a fish passage project, allowing fish to utilize habitat upstream of the previous barrier. At a low spawner level (50 females), the stream can produce about 4,000 smolts before the fish passage project (curve A), but over 5,000 smolts after the project opens up new habitat (curve B). At a high spawner level (400 females[13]), the stream can produce about 8,400 smolts before the fish passage project (curve A) and over 14,500 smolts after completion of the project (curve B), a 73% increase. Curve C represents the same carrying capacity as B, but with poor quality habitat that reduces the stream's overall density independent survival by two thirds. At a spawner level of 50 females, stream C can produce only about 2,000 smolts after the project, compared to the original 4,000 smolts of curve A. Smolt production for curve C does not equal curve A until the level of 300 female spawners, and only shows a minor increase (+ 12%), at the level of 400 female spawners.

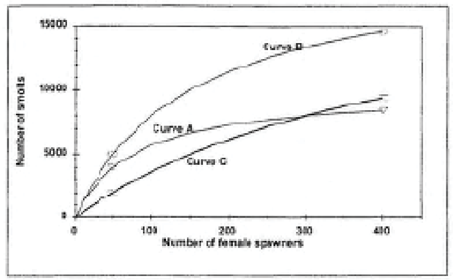

Figure 5-1. Beverton-Holt stock recruitment curves for a hypothetical coho stream indicating capacity (the asymptote) and survival (shape of the curve) for starting conditions (Curve A), doubled capacity (Curve B), and doubled capacity with survival reduced by two thirds (Curve C).

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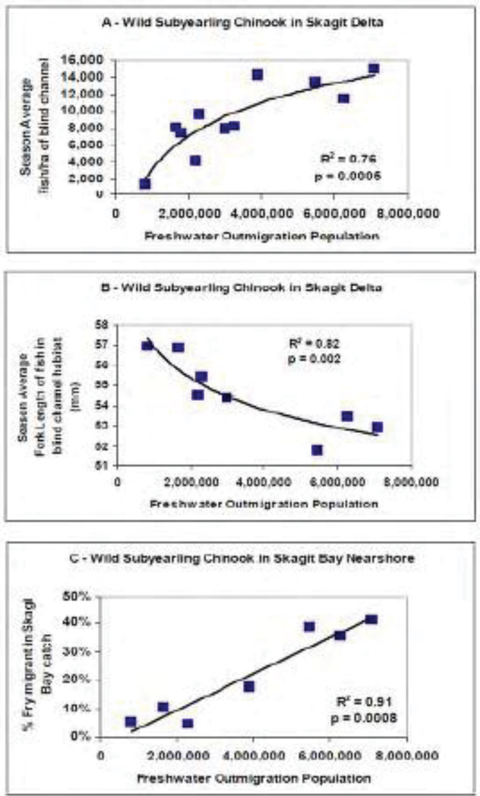
12 The rate is for female spawner to smolt stage, in streams where the mean winter temperature is < 7° C, from Reeves et al. (1989).

13 As in Lestelle et. al. (1993b), we consider streams to be "fully seeded" when spawner levels are sufficient to produce ≥ 80% of smolt carrying capacity. In this case, 400 female spawners yield 8,000 smolts, or 80% of carrying capacity.

(Beamer, *et al.* 1998).

Figure 4.1 from the Skagit Chinook Recovery Plan 2005, Appendix D (Skagit River System Cooperative and Washington Department of Fish and Wildlife 2005), demonstrates graphically the concept of density dependence and density dependence mortality in the Skagit watershed. As density (measured as the number of fish per unit area) increases, one would expect that the number of smolts migrating to sea would increase proportionately. However, one can see in the Skagit estuary that once a certain density is reached, that relationship changes and the number of outmigrating fish (smolts) declines. The figure also shows that the smaller the average size of fish, the lower the number of outmigrating fish. These figures demonstrate that as the number of available spaces in the estuary fill up, with the result that there is increased competition for food and space, the survival (measured as number of outmigrants in this case) declines. In this instance, more habitat equates to more fish. To summarize, the number of fish available for harvest and spawning is, in large measure, dependent upon having access to sufficient freshwater habitat to maximize the number of smolts that migrate to the sea. These figures demonstrate that decreasing density by increasing the amount of habitat almost always increases watershed productivity.

Figure 4.1. *Density dependence in the Skagit delta.*



(Skagit Chinook Recovery Plan, 2005).

There are a number of natural and anthropogenic causes for reduced survival of salmon in fresh and marine waters. Natural factors affecting populations include, but are not limited to, watershed productivity and available food supply, streamflows associated with precipitation, high temperatures, predation, and flooding, sedimentation, landslides, beaver activity, fires, windstorms and volcanos. These factors are all variable from year to year, and many can be influenced by human activities.

> One of the major problems facing salmon and trout populations is an inability to utilize their historic rearing and spawning grounds due to fish passage barriers that block access to upstream habitat.

Every species of salmon has been shown to be blocked by culverts, and blocking culverts have been found in every watershed within Puget Sound. A WSDOT literature review states:

> The conclusion of this literature review is that stream dwelling salmonids are often highly mobile. Upstream movement was observed in nearly all studies that were designed to detect it, and in all species, age classes, and seasons. There are variations in the movement patterns of fish populations both between and within river systems.

(Kahler and Quinn, 1998.)

It is generally acknowledged that removal of barrier culverts is a primary mechanism to restore Puget Sound salmon stocks. Fish blocking culverts are listed as a factor limiting salmon production in every watershed in Puget Sound. (Washington State Conservation Commission.) Culverts are also identified as a key factor necessary for recovery in almost every local watershed chapter of the Puget Sound Chinook Recovery Plan[1] as well as in the federal supplement to that plan. (National Marine Fisheries Service, 2006). While a recovery plan has yet to be adopted for the more recently listed steelhead,[2] similar life histories strategies between juvenile and adult coho and steelhead would indicate that similar benefits would accrue to steelhead as would be predicted for coho salmon.

Fish Passage has have also been listed as a critical component of the *Policy of the Washington Department of Fish and Wildlife and the Western Washington Treaty Tribes Concerning Wild Salmonids* adopted by the Washington Fish and Wildlife Commission (December 5, 1997) which has as its goal

> to protect, restore, and enhance the productivity, production, and diversity of wild salmonids and their ecosystems to sustain ceremonial, subsistence, commercial, and recreational fisheries, non-consumptive fish benefits, and other related cultural and ecological values.

Page 4, Policy statement 14 states:

> Provide, restore, and maintain safe and timely pathways to all useable wild salmonid habitat in fresh and marine waters, for salmonids at all life stages.

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[1] The Puget Sound Salmon Recovery Plan was approved by the National Marine Fisheries Services, National Oceanographic and Atmospheric Administration, Department of Commerce on January 19, 2007.
[2] Puget Sound Steelhead are listed as threatened under the federal Endangered Species Act. 71 Fed. Reg. 15666 (3/29/2006).

Ensure salmonids are protected from injury or mortality from diversion into artificial channels or conduits (irrigation ditches, turbines, etc.).

Ensure natural fish passage barriers are maintained where necessary, to maintain biodiversity among and within salmonid populations and other fish and wildlife.

Page 6. The document identifies the following performance measure for fish passage:

Provide and maintain free and unobstructed passage for all wild salmonids, according to state and federal screening and passage criteria, and guidelines at all human-built structures.

The Washington Department of Fish and Wildlife describes how culverts affect salmon in its revised manual entitled *Design of Road Culverts for Fish Passage* (2003). The report identifies the following impacts associated with culverts:

1. Culverts result in the permanent, direct loss of instream and riparian habitat.
2. Installation and maintenance of water crossings that confine or constrict the channel or floodplain will break ecological connectivity, alter channel processes and change adjacent channel character and shape by affecting the movement of debris, sediment, channel migration, flood waters, and aquatic and terrestrial organisms.
3. Water crossings may create an entry point for road-runoff pollutants.
4. Fish passage can be hindered or blocked at water crossings.
5. Water crossings increase the risk of damage to the downstream habitat due to water crossing failure.
6. Cumulative impacts and risks of water crossings can be avoided or minimized by consolidating water crossings; employing full-span bridges, by simulating a natural channel through culverts; or removing water crossings. Access solutions that do not require water crossings are preferred.

(Excerpt attached hereto as Attachment C). Impacts resulting from the installation, operation and maintenance of culverts can be divided into two categories: spawning and rearing fish passage impacts, and habitat related impacts.

A. <u>Spawning and rearing fish passage related impacts</u>.

Barriers to upstream access to spawning and rearing areas result in a number of biological consequences to salmon populations. As stated above, returning salmon, upon entering freshwater, cease feeding and depend on stored fat reserves to meet the energetic requirements for reproductive product maturation and spawning. If, as a result of encountering a barrier culvert, adult salmon are delayed in reaching their spawning areas, or must exert a great deal of energy attempting to ascend a barrier culvert, energy reserves are depleted, and the adults may die without spawning. Partial barriers, which by definition are barriers that are impassable for adult salmon for only a portion of the year, may have the same impact as complete barriers. The difference between partial and complete barriers is therefore merely one of what percentage of returning salmon may be affected by the barrier. In both instances prespawning mortality can occur. Those fish that cannot reach their spawning area and die unspawned do not contribute toward the total productivity of the watershed, and ultimately the number of smolts produced, and thereby adults, is reduced.

The following photograph is an example of a culvert on a tributary to the Nooksack River that will not allow for upstream passage of either adult or juvenile salmon because the distance between the water surface elevation and the bottom of the culvert is too great for the fish to ascend (enlarged version attached as Attachment D hereto)

Prespawning mortality can also occur where a culvert is a passage barrier due to either inadequate velocity or water depth, or where streambed erosion downstream from a culvert prevents access. If water velocities exceed the swimming speed capabilities of migrating salmon, they cannot ascend the culvert. Similarly, if the water depth in a culvert is too shallow, fish cannot ascend the culvert. Further, mortality can occur when adult salmon jump repeatedly when trying to ascend an inadequately constructed or operating culvert. In these instances fish may collide with the culvert creating impact injuries leading to mortality culverts.

Denial of access also results in increased spawner density downstream of impassable barriers, which may result in superimposition of redds, which can result in egg mortality. Further, if adult fish are precluded from reaching their spawning areas, then those fry that do emerge from the gravel will encounter an increased competition among emergent juvenile salmonids. As explained previously in Section IV, if juvenile densities are increased due to inadequate fish passage, the number of smolts produced will be reduced.

Barriers to upstream access reduce the spatial diversity of spawning areas for fish. This is important because having fish distributed throughout a watershed provides for a buffer from the impacts of a localized environmental damage. For example, if all the coho in a watershed were found in only one creek, and a landslide occurred in that creek, the population would be wiped out. If, on the other hand, coho were found in many creeks, the landslide would only affect a portion of the population. The watershed population as a whole could recover because there would be a continuing source of salmon to return from other parts of the stream system. This spatial diversity also provides for genetic diversity because it provides for local adaptation of discrete populations. As with the example of the landslide, fish populations with different genetic characteristics are able to withstand environmental change differently. A diversity of genetic characteristics adds to the overall robustness and survival of a population.

Adult passage barriers also reduce the productivity of streams. Salmon carcasses contribute significant beneficial nutrient sources to the watersheds in which they die. Both insects as well have fish have been demonstrated to use these carcasses as a food supply. Higher elevation streams are often more sterile than lower elevation streams, and these carcasses provide an important component of the stream ecosystem, which is eliminated if access is denied.

Barriers to juvenile and adult passage may eliminate salmon use in the best habitats within a watershed. In most watersheds, salmon habitat is more intact the further upstream one goes. Generally speaking, aside from logging activities, little human development has taken place in these higher elevation locations. These intact habitats provide a refugia for juvenile salmonids that may not be found in more environmentally compromised downstream reaches. The elimination of access to these habitats therefore has a disproportionately large impact on salmon populations because on a per unit area basis, the salmon habitat upstream might be much more productive than the habitat in lower elevation areas. One hundred (100) meters of habitat in a forested creek may produce significantly more salmon than in one hundred (100) meters of habitat in a downtown urban setting. Not only is habitat quantity compromised, but habitat quality may be as well. (Sheer and Steel, 2006).

Finally, with the onset of autumn rains, juvenile coho and steelhead move upstream into tributaries to seek refuge areas from winter storms. Movement into these refuge areas provide a critical element in the life history strategy of Pacific salmon. Passage barriers prevent this upstream movement, thereby subjecting juvenile fish to greater winter mortalities.

Along with my colleagues at the Skagit System Cooperative,[3] I conducted an analysis of the loss of coho salmon production within the Skagit River watershed. (Beechie, *et al.*, 1994). This award-winning article[4] found that between 6% and 13% of the loss of coho production throughout the Skagit watershed was found to be due to blocking culverts. We calculated that blocking culverts was the second largest loss of coho production in the Skagit River watershed, led only by the loss of habitat due to diking, ditching, dredging and bank protection. When evaluating the loss of coho production in tributaries alone, however, we determined that 44% to 58% of the loss could be attributed to blocking culverts.

B. <u>Habitat related impacts of culverts.</u>

In addition to creating barriers to the upstream and downstream migration of anadromous fish, culverts also affect the habitat upon which these fish depend. Washington Department of Fish and Wildlife (2003) describes the impacts of culverts on salmon habitat (Attachment C hereto). The entire manual can be found on line at http://wdfw.wa.gov/hab/engineer/cm). The following description summarizes the impacts of culverts on salmon habitat:

1. **Elimination of Spawning Habitat.** Culverts eliminate spawning habitat by replacing natural stream bottoms with metal or concrete pipes; by shortening streams due to channel realignment, by creating adverse velocities or by scour associated with higher than natural flows. Finally, additional sediments may be introduced into spawning areas as a result of culvert placement.

2. **Elimination of Rearing Habitat.** Culverts eliminate rearing habitat by replacing natural stream characteristics with those that are confined within a pipe. Habitat quality in the form of pools, riffles, and woody vegetation is rarely found within culverts. Riparian vegetation is often lost, and stream lengths may be shortened, to accommodate installation. The latter occurs when meanders are cut off to accommodate road rights of way. Undersized culverts increase stream velocity, thereby degrading habitat in both upstream and downstream directions. Habitat may be eliminated downstream by retarding the downstream movement of wood or by scouring habitat below the culvert when concentrated streamflows lead to higher velocities. Upstream habitat can be impacted when the stream bed upstream of the culvert erodes as a result of changing the natural stream gradient by placement of the culvert at a slope different from the original slope of the streambed.

The following photo shows the elimination of rearing habitat within a culvert (enlarged version attached as Attachment E hereto).

[3] The Skagit System Cooperative is consortium which represented the fisheries interests of the Sauk-Suiattle Indian Tribe, the Upper Skagit Indian and the Swinomish Indian Tribal Community. When the Upper Skagit Tribe withdrew from the consortium in 2004, the name changed to Skagit River System Cooperative and the consortium continued to represent both the Sauk-Suiattle and Swinomish Tribes. Its staff of almost thirty scientists focus on fisheries management, restoration, and research issues affecting the Tribes' treaty right to fish in the Skagit River Basin and those marine waters within which the T ribes have usual and accustomed fishing grounds.

[4] As mentioned in my declaration, this article won a citation by the American Fisheries Society for the Most Significant Paper in the North American Journal of Fisheries Management for 1994.

In contrast to the above photograph, the next photograph which is of an unnamed tributary to the Nookack River, shows a culvert with adequate substrate within the culvert (enlarged version attached as Attachment F hereto).

3. **Reduction of Food Supply.** Culverts reduce food production due to the loss of riparian vegetation within the culvert footprint as a source of terrestrial insect input, and as well as a result of diminished sunlight within the culvert which is an important component to aquatic insect production.

4. **Changes in Stream Velocities.** Undersized culverts create an upstream low velocity area during high flows which may result in unnaturally high rates of gravel accumulation. Lower water velocities cause gravels to be deposited rather than being exported downstream unimpeded. This deposition is quite unstable, and in addition to attracting fish to spawn within this unstable area, may direct streamflows towards the streambank rather than the main channel. These redirected flows have the potential to increase steambank erosion.

5. **Maintenance Impacts.** Undersized culverts frequently require maintenance that can have devastating impacts of salmon. Undersized culverts can fill with sediment following storms. Dredging is often required to open up the culvert and provide space within the culvert to allow water to freely flow. This dredging is not limited to the footprint of the culvert, but frequently extends for a considerable distance both upstream and downstream of the culvert.

Channel migration, which refers to the lateral movement of water within the valley bottom of a stream, is a natural occurrence that is important to sustain salmon habitat. In addition to dredging to maintain adequate flow capacity within the culvert discussed above, streams frequently are dredged to ensure that stream channel migration does not result in the stream eroding the road prism rather than going through the culvert. These dredging operations destroy existing salmon habitat by removing in-channel woody debris and a natural pool riffle stream depth sequence, both of which are important for salmon rearing.

Red Cabin Creek provides an example of these problems, both from a fish passage standpoint and an ecosystem function standpoint. The following series of photographs show Red Cabin Creek following a storm event (enlarged versions attached as Attachments G-K hereto). The culvert is completely filled with sediment. When this occurs, as it does in some years, water and fish run over the road, and fish cannot easily pass downstream. These series of photographs show the following:

The photograph below (Attachment G hereto) shows the culvert filled with sediment in December 2004 prior to dredging.

The photograph below (Attachment H hereto) shows a similar occurrence in on February 20, 2009.

The photograph below (Attachment I hereto) shows the blocked culvert at the downstream end of the culvert.

The following photograph (Attachment J hereto) shows the culvert at Red Cabin Creek after the streambed has been dredged.

The following photograph (Attachment K hereto) shows a number of dead unspawned salmon stranded as a result of Washington State Department of Transportation dredging activities whereby fish were attacted to the excavated area and could not escape once flows diminished. (Personal Communication, Keith Wyman.)

The final photograph of Red Cabin Creek (Attachment L hereto) shows that on closer inspection, not only there a number of dead adult salmon, but numerous juvenile salmon that have been stranded (and subsequently died) as a result of the WSDOT maintenance activities. (Personal Communication, Keith Wyman.)

The undersized culvert in Red Cabin Creek has a number of impacts on fish. When sediment accumulates, salmon frequently spawn in the aggraded streambed. Subsequent dredging activity by WSDOT eliminates the salmon nests. The excavation by WSDOT is undertaken to remove sediment to allow water to freely pass under the road. Unfortunately, the excavation creates a hole that fills with water and attracts both adult and juvenile salmon when stream flows dropped in the fall. These photographs show salmon which were attracted to the excavated area, and could not escape once flows were further reduced in 2004. Had this culvert been properly sized, no excavation would have been necessary, and salmon would not have been attracted into the hole, to later become stranded and die. The loss of these fish in this manner could have been avoided.

While these photographs show the impacts from maintenance dredging in 2004, it is not an isolated incident as WDFW biologist Kurt Buchanan recognized. Buchanan advised both his department and WSDOT of "the ongoing damages caused by the SR 20 culvert, and dredging required to maintain it. … The documentation of fish damage is likely to increase, not decrease." . Email from Kurt Buchanan to Greg Hueckel and Pat Chapman, with copies to Bob Bicknell, Craig Olds, Gayle Kreitman, Rich Costello, and Rich Johnson dated 12/6/2004 (Attachment M hereto). Mr. Buchanan described the "negative impacts of long-term dredging" in an attachment to his Email, specifically reporting "emergency dredging is likely to occur in 04/04-05—the culverts and creek channel are nearly full again. Flagged redds are within the normal dredging area. The culvert and channel cannot be dug without destroying the redds already in place." As early as 2002, this culvert has been known to be a problem. As WDFW stated in the Hydraulic Project Approval issued for Red Cabin Creek maintenance activities by WSDOT: "Repeated maintenance dredging of this stream by the Washington Department of Transportation (WSDOT) constitutes an unacceptable adverse impact to fish life. The Department of Fish and Wildlife (WDFW) views replacement of this crossing, with the appropriate sized bridge, or other approved structure, as the preferred alternative to dredging." Hydraulic Project Approval dated August 19, 2002 (Log # ST-F0760-03) issued (Attachment N hereto). Despite knowing about the adverse impacts to salmon as a result of an improperly sized culvert for at least 7 years, at the time of this report the original culvert is still in place, and maintenance dredging, with the ensuing impacts, has continued.

The following two photographs of Bruce Creek, a tributary to the Nooksack River, demonstrate a culvert blocked by sediment and the loss of riparian and instream habitat after dredging had occurred to remove the sediment (enlarged versions attached as Attachments O and P respectively).

6. **The movement of wood, water and sediment is impeded.** Culverts may impede the movement of water, sediment and wood and each can have devastating effects on salmon habitat. If water, wood or sediment cannot adequately pass

through a culvert, the culvert may become plugged. If the culvert becomes plugged, the upstream hillslope may become saturated, and if that occurs, it may lead to a landslide or road failure. Alternatively, a plugged culvert may develop a debris torrent, which results from the impounded water and sediment associated with the plugged culvert overwhelming the culvert similar to a dam break. In either instance, the culvert becomes overwhelmed and there is a tremendous and rapid release of wood, water and sediment sent cascading downstream and depositing sediment, flooding the stream, and unleashing significant erosive forces. The effects on fish populations can be devastating. Both landslides and debris torrents can inundate salmon habitat for thousands of meters downstream of a blocked culvert. Undoing these effects and restoring the habitat can take many years and millions of dollars.

The following photograph of a beaver dam constructed on a culvert located on Bear Creek in the Nooksack watershed is an example of how culverts may become blocked (enlarged version attached hereto as Attachment Q hereto).

The recruitment of wood that can accrue from a long distance upstream of a culvert and be transported far downstream can be impeded by an inadequately sized culvert, and this loss of downstream wood can significantly reduce salmon production. The legacy of logging, agriculture, and development has resulted in severe reductions in mature streamside vegetation. Much of the most intact riparian vegetation is found in the upper portions of watersheds. If fish passage structures are not sized to accommodate the transportation of wood, in addition to increasing the possibility of landslides and debris torrents, they retard the movement of wood to downstream salmon habitats, which as I describe earlier in this report is so critical to salmon.

VI. REASONS REPLACING CULVERTS TO PROVIDE FISH PASSAGE AND RESTORE ECOLOGICAL FUNCTIONS MAKES SENSE.

As commonly recognized by fisheries biologists and as stated by Brett Barkdull, WDFW fish biologist, "Correction of human-made fish passage barriers is one of the most cost effective methods of salmonid enhancement and restoration." Barkdull, Brett. January 2001. Owl Creek Fish Passage Assessment, p. 1. Roni, *et al.* (2002) found that "reconnecting isolated off-channel habitats or blocked tributaries provides a quick biological response, is likely to last many decades, and based on available evidence, has a high likelihood of success. Generally, these types of restoration activities should be undertaken before methods that produce less consistent results." The replacement of barrier culverts is also cost effective and generally accepted restoration action. The benefits associated with replacement of inadequately functioning culverts are as follows:

A. Immediate Access to Additional Habitat.

Beamer, *et al.,* 1998 shows that providing fish passage increases the availability of habitat. An increase in habitat decreases density, and therefore increases survival and smolt production. Culverts provide immediate access to additional habitat, thereby increasing survival. (Pess, *et al.*, 2003; Pess, *et al.*, 1998; Barkdull, 2001). The benefits, therefore, are immediate, as compared to other types of restoration efforts that might take years to have an effect, such as riparian planting. Beechie, *et al.* (1994) showed a significant impact on Skagit River coho salmon production resulting from fish passage barriers, particularly in the tributaries. Removal of these obstructions could significantly increase salmon production in this basin. Pess, *et al.* (1998) showed over 250 adult coho salmon were observed above corrected barriers for each of the first two years following culvert replacement.

B. Higher Level of Confidence in Design.

In contrast to other salmon restoration efforts, the science about moving fish upstream is more developed. Although there are uncertainties about passing juvenile fish upstream that should be evaluated through adaptive management, the state of knowledge about fish passage and culvert design is such that we have the ability to design crossing structures, *e.g.,* bridges and culverts, with a high level of confidence such that they will allow adult fish to have unimpeded passage at most flows where fish need (or seek) passage

C. Easier monitoring.

Monitoring for effectiveness of culvert replacement is much easier than for many other types of habitat restoration efforts. Culverts that were complete blockages to migrating adult salmon can be readily sampled to determine if salmon are present where prior to replacement they did not exist. Estimates of densities or presence of juvenile salmonids can be readily monitored as well. The same can be said for measuring the physical results of culvert replacement. Habitat measurements can be confined to a relatively small portion of stream length, and the number of parameters to be measured, *e.g.,* slope, presence of substrate within the culvert, and impacts to upstream and downstream portions of the stream channel, can be rather limited and well defined.

D. Minimal Impacts on Land Use or Private Rights.

The installation of a culvert generally requires little changes in surrounding land uses. The footprint for the installation is generally within existing rights of way, so impacts to private landowners are minimal. This avoids the political or social challenges that often occur when attempting to implement restoration projects that require changes in the activities or properties of affected landowners. Replacement of culverts is generally well accepted by the public as a cost effective measure for salmon protection and restoration.

E. <u>Cost-Effective Strategy</u>.

Culvert replacement has been shown to be a cost effective strategy for the recovery of salmon populations. In evaluating restoration actions, Beechie *et al.* (1996) reports

> removal of access problems (*e.g.*, impassable culverts) appears to be the lowest cost restoration, because an access problem is localized and relatively easy to restore, and smolt production increases are relatively large and immediate.

This conclusion was based on an analysis that evaluated the cost per smolt produced by culvert replacement, construction of groundwater channels, or the introduction of large woody debris structures. Culvert replacements were found to be from 1.7 to 29 times more cost effective than these other two restoration actions.

F. <u>Benefits Throughout Stream System.</u>

The benefits of replacing culverts that are compromising ecological functions, such as impeding the movement of wood, water and sediment, extend far beyond the immediate area of the culvert. The avoidance of a debris torrent that might occur because water, wood or sediment cannot pass through a culvert during a storm, has benefits throughout the stream system, and the cost of protecting salmon habitat outweighs costs of restoration both in terms of dollars spent and time necessary for recovery. (Beamer *et al.*, 1998.)

VII. TRIBAL EFFORTS TO PROTECT AND RESTORE SALMON

For many years, the case area Tribes have dedicated a significant amount of time and resources toward the protection of salmon resources. There has been a long history of Tribes working collaboratively and within the confines of both State and Federal law to protect Tribal resources. Some of these collaborative efforts are:

A. <u>Timber Fish and Wildlife and Forest and Fish Program</u>.

This program is an intertribal effort to work with the State of Washington, small and large timberland owners, and the environmental community to protect fish and wildlife resources from the impacts of forest practices activities.

B. <u>Water Resources Forum</u>.

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
IN SEATTLE

UNITED STATES OF AMERICA, et al, Plaintiffs, v. STATE OF WASHINGTON, et al., Defendants.	No. C70-9213 Subproceeding 01-10

TRANSCRIPTS OF PROCEEDINGS

BEFORE THE HONORABLE
RICARDO S. MARTINEZ

October 14, 2009

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couple of questions of this witness.

Mr. McHenry, understanding that I've not yet had a chance to review your declaration, you've testified that habitat restoration is a very complex thing. Prior to this litigation beginning, the Lower Elwha Clallam Tribe realized that it needed to do something to address these restoration efforts, correct?

THE WITNESS: Yes, sir.

THE COURT: As you have testified, and as the cross-examination showed, there are many specific areas that could have been addressed as part of that ongoing effort.

THE WITNESS: Yes, sir.

THE COURT: Given the obvious limitation that there are insufficient funds to do everything necessary, your tribe decided to go ahead and fix or address -- try to fix 17 barriers out of the 31 that have been identified in this area?

THE WITNESS: In the Salt Creek watershed, that's correct.

THE COURT: Out of all the things that could have been done, why did they decide to try to fix the barriers as one of their highest priorities?

THE WITNESS: Because when we did the watershed assessment, we found that there were 50 miles of historically active stream that salmon could access in this watershed, and fully half that mileage was blocked by culverts of various ownerships. So to us, we applied our scientific knowledge,

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recommendations from the literature which indicated that when you're going to restore a place like this, you need to go after the barriers first.

THE COURT: In your expert opinion, that was the biggest bang for your buck?

THE WITNESS: Yes.

THE COURT: Thank you.

THE WITNESS: Thank you.

THE COURT: Ms. Foster.

MR. FOSTER: Thank you, your Honor. Yesterday, your Honor, the Court reserved ruling on AT-004 with regard to the last section of that particular report.

THE COURT: It was actually Pages 12 and 13, the culvert correction success, that the State had objected to.

MS. FOSTER: Yes, that's correct.

THE COURT: After listening to the testimony, Counsel, the Court will overrule the objection and will admit those portions.

MS. FOSTER: Thank you very much, your Honor. I also neglected to move for AT-084, which is a hydraulic permit approval, during Mr. Wasserman's testimony, and would so move now.

THE COURT: Is that AT-008-4?

MS. FOSTER: No. It's AT-084.

THE COURT: The Red Cabin Creek?

October 15, 2009

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THE COURT: You may inquire, Counsel.

DIRECT EXAMINATION

By Mr. Nielsen:

Q Mr. Johnstone, where do you live?

A I live at Tahola, Washington, on the Quinault Indian Reservation.

Q Where is the Quinault Indian Reservation located?

A It is just north of Grays Harbor in the mid Washington coast.

Q Are you an enrolled member of the Quinault?

A I am an enrolled member.

Q How old are you?

A I'm 56.

Q Are you a descendent of any of the signers of the treaties?

A Yes. My grandmother was from Hoh River, and our family on the Hoh River side were the treaty signers.

Q And Mr. Johnstone, what do you do for a living?

A I'm a fisheries policy spokesperson for the Quinault Indian Nation.

Q And can you briefly describe in general terms what that means. What is your job? What do you do?

A Well, it generally means that anything that has to do with policy in the fisheries arena, that's what I do. I work directly with the fisheries division and handle any of the policy issues.

Q When you say you work directly with the fisheries division, what is the fisheries division?

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A Yes. When I talk about my Hoh River family, it's exclusive, the only income that my brother-in-law has ever known, and he's 73 years old. It was his entire life.

Q Are there tribal members now who rely on salmon fishing to support themselves economically?

A In the Quinault Tribe, there are several.

Q And does your family still rely on salmon as a source of economics?

A Very much so. I have nephews that fish full-time and work, I guess seasonal work when it's available.

Q Now, in Quinault practices -- well, first off, are you familiar with the role salmon has played in the Quinault culture and tradition?

A Well, in our language, the word for "salmon" is the equal word for "food." It's very much a part of us as Indian people. The salmon were the buffalo of the great plains when there were 60 billion. You know, salmon are our buffalo. It is intertwined within our culture. Our songs, our ceremonies, our subsistence coincide with the salmon. When salmon are not plentiful, we suffer. When salmon are plentiful, we basically are rejoicing, we're happier, but we're also mindful of what that means to us. It means that when they're plentiful, that you take care of your harvest, you take care of your needs, your smoke and your can and your freezing, all of those things. And always, we take care of our elders. We take care of

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those that can't provide for their selves first and foremost: our babies, our grandmothers, our grandfathers and our children, and our elders. That's just the way Indian people are.

Q And salmon is an important part of taking care of the children and the elders?

A Yes, it is.

Q And you mentioned ceremonies. How in Quinault culture is salmon used ceremonially? Can you give us a brief description of that?

A Well, salmon are used in all events as well as all of our foods. Salmon is the center pin, for instance, of our culture. If you look at Quinaults, we have a particular stock of salmon called the Quinault Blue Back, or the Sockeye. It's a Sockeye salmon. It is known actually throughout the world.

It is basically the foundation of who we are. We're talking about a run of fish that once numbered into a million. In the last century, there were runs of a million fish. In the last seven years, we had the lowest run ever recorded, at like 7,200 fish. So our connection is deep. The relationship to the salmon is ever present.

And we use salmon for name givings. We use salmon for deaths, for burials, for recognitions, for birthdays. Ceremonial events, we would use particularly the Quinault Sockeye.

Q When you testified that -- I think you said Blue Back; is that correct?

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these projects, about $280,000, that's certainly an order of magnitude below what these DOT projects are costing today.

Q You mentioned prioritization and the development of the prioritization process and the manual.

Why is it important to prioritize culverts for correction?

A Well, we felt it was important so that -- front load benefits. We knew that some projects, you would gain more fish or access for more fish, so that would be one aspect of prioritization.

There are other aspects of how much it would cost to correct a project, the status of the stocks that were effected, the mobility of those stocks when you were dealing with anadromous fish or only resident fish. So these are all factors that we felt needed to be in the prioritization process.

It basically was a surrogate for a cost benefit, but we felt it did a better job of prioritization than a formal cost benefit analysis.

Q You testified a bit this morning about the Fish Passage Priority Index, and you described a little bit about your role in developing that. I would like to go into a little bit more detail.

What is the Fish Passage Priority Index?

A Well, it is a unique number that is calculated for each barrier culvert. And what that lends itself to is a comparison of numbers from other barriers. The range that is expected with

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utilization of priority index is 1 to 100. The higher the number, the higher the priority. There are six factors within the priority index. I think I alluded to some of those in general terms.

Basically there are three modifiers within the priority index for each species. That is the cost stratification of the project, to correct it; the status of the stocks, whether they are depressed or not; again, whether they are anadromous or not.

And then critical pieces of the priority index are the first three factors. I used the BPH. The BPH represents B, being the passability of the culvert, a rough approximation of that; P, the productivity capability of the species that is being calculated, those being different for each species; and then the habitat that a species would utilize after the correction is made.

Those factors are multiplied together. There's a quadratic root calculated for those factors for each species. And then once those are calculated for each species within a drainage, then those are added together to give you the final PI number for that crossing.

Q How does the Washington Department of Fish and Wildlife collect the information necessary to collect to compute a priority index number for a culvert?

A Well, we've had inventory crews. And those that were inventorying DOT roadways, we receive money from the Department of Transportation to do that work. And basically what starts out

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as a driving roads, looking where those crossings are, looking at the site, taking measurements, assessing whether the facility is a barrier or not.

If it's determined that it's a barrier, secondly, then determine if there's a significant amount of habitat that the barrier's affecting that is 200 meters upstream and downstream.

Once that threshold is met, then an in-depth habitat survey is done where various measurements are made of the habitat to determine the habitat that is unique to each species being affected.

Q Once you've assembled all that information, what do you do with it?

A Well, through the help of my staff, we developed a database to compile all that information and do the calculations of the priority index. It resides in what is called the Fish Passage and Diversion Screening Inventory Database. That's undergone several names. At one time, it was called SHEAR base.

But all the data for the inventory crews in Fish and Wildlife are compiled there. All of the inventories that we did for counties, the data resides there. And also if we provide technical assistance to grant groups that secure money through the SRF Board, those data also reside there.

Q When you calculate a priority index number for a culvert, do you account for the presence of other fish passage barriers in a watershed?

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A We account for it only insofar as it's recorded as reach breaks in our habitat surveys. When the priority index is calculated, it treats those other barriers as transparent. The reason we do that, we don't know when those other barriers are being corrected. So by treating them as transparent, you do a priority index that looks at potential habitat gain as if all those barriers would be corrected at some point in time.

Q And by "transparent," what do you mean?

A What that means is if you're walking the watershed, and perhaps there may be ten barriers, to look at the total potential, you walk the whole stream past every one of those barriers measuring the habitat, and those become an integral part of the priority index. If you didn't do that, you would only calculate a priority index up to the next barrier, and then you would stop your survey. That wasn't our intent, because that's drawing a conclusion that that next barrier and the eight after that would never be fixed.

Q Optimistic way of looking at things.

If we fix a fish passage barrier culvert in a watershed that has other barriers upstream, will the potential benefit of fixing that barrier be immediately realized?

A Generally no.

Q Why not?

A Well, if you open the habitat and the fish start utilizing or passing the previous barrier, they're going to butt up against,

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in some magnitude, to the next barrier. And of course the amount of that decline in potential production depends on the degree of passability of subsequent facilities.

Q I think you testified you worked for the Washington Department of Fish and Wildlife a little over 25 years?

A That's correct.

Q Why did you stay so long?

A I knew you were going to ask that. I guess the short answer is I just really enjoyed working with people and supervising people that were extremely dedicated to protecting and enhancing the resources of the state. It would have been a very difficult job had you not had good staff working for you to implement good ideas, I guess act as you in your own ideas. It made it real easy.

Q Are some of your staff in the courtroom today?

A Yes, they are.

MS. WOODS: Thank you.

THE COURT: Counsel, before you start, let me ask him one question that may help you also in your cross-examination.

Dr. Sekulich, I haven't read your direct testimony as of yet. But in all the years and all the work that you did, in looking at how to address this very complex problem that everybody wants to fix, if Mr. Monson's client over there came up with a pot of stimulus money, a big pot, would you do anything different than the way you've set it out?

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THE WITNESS: In terms of the prioritization?

THE COURT: I don't want to make you nervous over there.

Yes.

THE WITNESS: No, not in terms of the prioritization method.

THE COURT: Thank you.

You may cross-examine.

MR. SLEDD: Thank you, your Honor.

CROSS-EXAMINATION

By Mr. Sledd:

Q Good afternoon, Dr. Sekulich.

A Good afternoon.

Q I'm John Sledd. You'll probably remember we first met underneath the conference table during the earthquake at your first deposition?

A I think Mr. Hallowed was taking pictures.

Q The infamous cellphone pictures.

When you were employed at WDFW, you supervised a unit that goes by the acronym of SHEAR; is that correct?

A Yes. That was a name I coined when I first took the job in habitat management.

Q Can you spell it and tell us what it stands for?

A It started as S-H-E-A-R, which was Salmon Habitat Enhancement and Restoration. That's when we were then the Department of Fisheries and our responsibility was only for salmon.

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Q And then in your last year or two with the State, there was some reorganization of the SHEAR program. It sort of morphed into the habitat and passage project section of the technical applications division; is that correct?

A It did. There were some intermediate steps before then.

Q And the SHEAR program, when you were directing it, you produced an annual report, did you not, to describe the activities of the program?

A We didn't start the annual reports until probably the mid '90s, but there were other reports that we jointly did with the Department of Transportation.

Q But there those annual SHEAR reports, for example, in 1997 to 2001 or so --

A That sounds right.

Q And then after the name change, when that became part of the technical applications division, the habitat and passage project section, did that annual reporting continue until you left the department?

A Yes.

Q And you supervised the preparation and did a good bit of work on each of those annual reports?

A Yes. Most of the work was outlined, directing staff to complete portions of the report. That's correct.

Q Now, you started doing habitat work at DFW, I believe you testified, in 1990?

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A Actually, it was 1991.

Q And it's your opinion, is it not, that prior to your starting your tenure with the DFW, or the Department of Fisheries, a significant portion or most of the culvert structures that were installed in the state were barriers from the minute they were installed; is that not correct?

A I believe there was a significant number that were.

Q And that opinion's based on your personal observation of culverts as well as input from your staff while you were with DFW?

A That's correct.

Q The 1990 MOU, Exhibit W-087-B that you were asked about, that didn't enable DFW to do anything that it couldn't have done before, did it?

A No, it didn't.

Q Because, as I believe you say in your declaration, there have been fish passage laws on the books in the state of Washington since the late 1800s.

A That's correct.

Q The 1990 MOU just profiled the need and raised people's awareness of those laws; is that correct?

A That's correct.

Q If you could take a look at Exhibit 87-B. If you could look down at the bottom of the first page. You should see there about four or five lines below the word "purpose," it says, " In order

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to accomplish this purpose, the respective participating agencies hereby agree as follows:"

And then after that for several pages there's descriptions of responsibilities. And to the left of each, there's an agency acronym; is that correct?

A That's correct.

Q And if we turn to the eighth page, in the lower right, there is a long number, T10 etcetera 40. It is the eighth page in.

There's a heading you should see in the middle of the page that says "Fish Passage Barrier Removal and Maintenance Program."

A I see it.

Q The first item under that heading states, "The Department of Transportation was to be responsible to," quote, "maintain culverts and fish passage facilities in a manner which provides continued fish passage for the life of the installation."

Do you see that?

A I do.

Q The Department of Transportation did not in fact maintain all its culverts and fish passage facilities to provide continued passage after this MOU, did it?

A Despite its best efforts, no.

Q As I understand the testimony -- you've been in the courtroom pretty much the whole trial, haven't you?

A I have.

Q There's been some discussions about DOT funding for

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corrections in reference to the I-4 program?

A Yes.

Q That's funding that is appropriated by the state legislature to the Department of Transportation specifically for fish passage barrier corrections, right?

A That's correct.

Q Now, the PI, or prioritization process that you just spoke about a moment ago, is used for prioritizing DOT corrections that are going to be funded with that I-4 funding, correct?

A That's correct.

Q It is not used for prioritizing corrections that are going to be done as part of a road project that happens to have a barrier in the project area?

A That's generally true, yes.

Q In that prioritization process for the I-4 funded corrections, is a culvert with less than 200 meters of upstream habitat treated differently than one that has more than 200 meters?

A In the inventory process?

Q In the prioritization process.

A Yes.

Q And the culvert with less than 200 is assessed, the data's kept in the data base, but it's not prioritized for correction with those I-4 funds?

A In general, that's true.

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Q But do you just write off that barrier and say, we're not going to fix it?

A No, we do not. It's kept on the databases of barriers with the presumption that when there is road work safety mobility projects, for example, that the fish passage barrier will be corrected concurrent with that work.

Q And the reason you do that is because biologically, even though it's a short amount, there's still going to be benefit from correcting that?

A That's correct.

Q In your declaration -- you've still got it up there with you, don't you?

A Yes.

Q Can we look at Paragraph 48? I'm sorry. You probably don't have it.

You state in Paragraph 48 that when DFW formulated its current fish passage regulations for culverts back in the 1990s, there was not much information available on the swimming abilities of juvenile salmon?

A I think I'm in the wrong place there. Is it 48?

Q Excuse me for a second. Sorry about that.

It states, "As of '94, little information was available about the swimming abilities of juvenile salmon, so we used a six-inch trout as the closest surrogate," correct?

A That's correct.

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barrier again, correct?

A Yes. You would want a monitoring program.

I might add to that, though, that the type of correction that you make would determine the, I guess, frequency that you would have to reinspect those facilities to see if they were still passing fish.

Q So if you used correction designs that minimize the chance for hydraulic changes to create an impassable condition, it could lower your monitoring burden?

A That's correct.

Q When I was asking you about the 1997 legislative task force report - or it may have been when I was asking you about the SHEAR reports - you mentioned a number of other reports done jointly with DOT. I want to ask you about one of those.

MR. SLEDD: Madam Clerk, if you could hand the witness Exhibit AT-54, please.

THE WITNESS: What was the number again?

By Mr. Sledd:

Q This is AT-54. It's a Fish Passage Program Department of Transportation Inventory Final Report.

A Can I just look at the screen?

Q That's absolutely fine. Whatever is easier for you.

Did your fish passage program work with DOT and prepare a series of not quite annual, but as time went on became more close to annual progress performance reports regarding the joint work

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between DFW and DOT regarding DOT culverts?

A Yes, we did.

Q And this is one in that series of reports?

A Yes.

Q And if I am correct, it has already been admitted in evidence.

You approved the content of these reports when this were prepared by staff under your supervision?

A That's correct.

Q If we could turn to Page 3 in the final report, the first paragraph. Four lines down there, it states, "One habitat-related cause for weakening of salmonid production, which can be easily resolved, is human-made barriers to fish migrations caused by improper placement of road culverts."

Do you see that?

A Yes, I do.

Q By that statement that it is easily resolved, what you and your staff meant was that fish passage barriers were easier to fix than those habitat problems described in the previous paragraphs, such as hydropower, habitat degradation, easier to deal with than oceanic events; is that correct?

A That's correct.

Q If we could look to Page 2, please, in Exhibit AT-54. In the third paragraph on that page, the next-to-the-last sentence -- are you with me?

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A I think so. On my screen here -- is it the last full paragraph?

Q Yes, it is.

A Okay.

Q The next-to-last sentence in that last full paragraph on your screen states, "A total potential spawning and rearing area of 1.6 million meters squared," and some change, "is currently blocked by WSDOT culverts on the 177 surveyed streams requiring barrier resolution. This is enough wetted stream area to produce 200,000 adult salmonids annually."

Now, you were the major player in preparing that statement and doing those calculations, were you not?

A Yes, I was.

Q And those calculations are based on the percent passability, or B factor, the P or production factors, and production coefficients, and the H, or habitat values, that are described in the priority index?

A With the understanding it is all under the umbrella of potential production.

Q Correct. So that is the potential annual adult equivalent salmonid production?

A That's correct.

Q An adult equivalent means that's a fish that actually would end up in either harvest or escapement as an adult?

A That's correct.

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Q So that it's after ocean mortality and other mortality factors?

A Yes.

Q You included that statement about the 200,000 fish in this final report in order to convey to the state legislature that there was a real benefit to the money the legislature was appropriating for culvert corrections, was it not?

A That's correct.

Q And I believe your declaration describes these factors in the PI and the BPH combination as being properly used only in a relativistic sense, to compare the benefits between one project and another?

A For that purpose, and also to compare correction schedules, where it's still a relative comparison.

Q This 200,000 additional salmon statement was not comparing the relative benefits of two projects, though?

A It was not, but it was a result of a cost benefit analysis that I did at that time.

Q But it was not comparing two different projects?

A No, it was not.

Q And it was not comparing two different schedules?

A No. It was a result of such analysis.

Q But it's not stated in the report?

A That's correct.

Q You said this is an outgrowth, I believe, of a cost benefit

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analysis?

A That's correct.

Q And you did that analysis?

A Yes.

Q But in your opinion, it's impossible to do a cost benefit analysis on a single culvert and determine what the benefit of the fish coming back to a single correction is?

A I don't think it's impossible, but it's very difficult.

Q Dr. Sekulich, I'm going to read to you the question and response from your deposition of April 22nd of 2009, Page 69 at Lines 3 to 9.

Question: "So the legislature, you think, wanted a project-by-project cost benefit?"

Answer: "Yes."

Question: "And you didn't think that was possible?"

Now, if you wanted to do a cost benefit on the overall programatic level, not individual culverts but the whole correction program, you believe you could do that?

A I believe it's much easier and it makes more sense.

Q And if you wanted to do that, you don't know of any better method to do than the BPH method, the percent passability, the cost of production coefficient times the habitat areas, do you?

A In my opinion, on an individual project, the priority index methodology is the best.

Q And if you want to prepare an estimate for the entire

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program, you don't know of a better methodology than that?

A Than the priority index methodology or the cost benefit analysis?

Q Than the BPH methodology that's a portion of the priority --

A It's a portion. I think it's a good methodology, yes.

Q And you don't know of a better one to come up with a cost benefit for the entire --

A Not without thinking about it more, no.

MR. SLEDD: If we could have on the screen, please – if I could have the clerk deliver to Dr. Sekulich Exhibit AT-154?

I'm sorry, your Honor. It's not admitted yet, so perhaps I should have it on the screen and not publish it to the witness.

By Mr. Sledd:

Q I'll botch this, but it's my last question.

A Are you hoping it's a good one?

Q It's a doozy.

Do you recognize that document, Dr. Sekulich?

A I do.

Q And it has your name on it underneath the title, correct?

A Yes.

Q And is that a document that -- the date down there, November 9th, 1999, do you see that?

A Yes, I do.

Q And that was during your tenure with the Department of Fish and Wildlife?

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it, in addition to the information about the designs of these projects.

THE COURT: Thank you, Mr. Shaftel.

Let me ask a couple of questions, Mr. Wagner. Looking at 092. Not the one on the screen, 113, but 092, this is the earlier version you've indicated?

THE WITNESS: That's correct.

THE COURT: Mr. Shaftel says that 113, the one on the screen, was not available to you at the time your declaration was put together.

THE WITNESS: That's right. This is an update to those cost estimates.

THE COURT: Who creates this document?

THE WITNESS: This table itself is created as a summary by my staff.

THE COURT: Your staff?

THE WITNESS: Yes.

THE COURT: All right, gentlemen. The Court will overrule the objections, and 113 will be admitted.

By Mr. Shaftel:

Q Now, Mr. Wagner, I'd like to ask you a couple questions about the scoping that's reflected on this particular document. Why did we do all this scoping?
A Scoping is very important to get a handle on what the costs would be as well as to get agreement on the type of fix. Our

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intent here is -- as I mentioned, the fish passage program has evolved as we've worked to improve it over the years. One of the things that we're working on is to really emphasize scoping so that we have more projects that can move on to design and more projects that are ready for construction ultimately.

Q And do you know how many projects -- I'm sorry. Is this a comprehensive list of everything in the scoping process?

A No, it's not. We have scoping -- projects that are in the scoping process that haven't been brought to the completion that these have, and we also have projects that have been scoped in other geographic areas.

Q And do you know how many projects were listed on this particular scoping list?

A It says 38 projects.

Q Have you calculated what the average cost reflected in the "Estimated Cost" column is?

A Yes. The average cost of all those 38 is about $3 million.

Q And I notice there's one project on here that seems quite a bit higher than the rest. It's SR 3 Chico Creek at $29 million. Have you also done a calculation that would remove that extremely higher cost?

A It is a very high-cost project. If we took that out and averaged the remaining 37, it would be an average of $2.3 million apiece.

Q And how do you think this sample of approaching projects

[Original Page 27]

compares to other remaining projects that have yet to be scoped but would still need to be corrected by the Department of Transportation, in terms of the size of the projects?

MR. JOHNSEN: Objection, your Honor. This is beyond the scope of anything in his declaration. His declaration is his testimony. It is not a summary.

MR. SHAFTEL: Your Honor, I believe he talks about costs and how they've changed over time. He talks about the number of barriers that are remaining. He's just merely -- trying to provide context for this particular document and the costs reflected.

THE COURT: Overruled.

You may respond. Do you do you remember the question?

THE WITNESS: Could you repeat that, please?

MR. SHAFTEL: Yes.

By Mr. Shaftel:

Q How does the averages that you just mentioned -- or, I'm sorry, how does the list that you see here and the size of the projects reflected here compare to the size of the projects that have yet to be scoped or corrected but still need to be corrected by the Department of Transportation?

A I think these are pretty typical of projects that we are scoping now and have not concluded the scoping to. We are definitely finding as we go into our list we are adding more and more complex projects, and there may be a number of very high

[Original Page 51]

mischaracterizes Dr. Sekulich's testimony. I believe he said some of them may have been. I don't believe he said almost all of them.

THE COURT: The objection to the form of the question is sustained.

By Mr. Johnsen:

Q Do you recall Dr. Sekulich testifying about fish passage barriers in the case area last week?

A I do.

Q Do you disagree with any part of Dr. Sekulich's testimony regarding the passability of Department of Transportation culverts in the case area in the last week?

MR. SHAFTEL: Objection. Overbroad.

THE COURT: Overruled.

THE WITNESS: Not that I can recall.

By Mr. Johnsen:

Q Going back to Page 5 of your declaration, Paragraph 9. This, I think, is just a clarification point. You make reference in that paragraph to the industry -- it is right at the bottom, Line 26, the industry standard for the design of road culverts for hydraulic purposes. Do you see that?

A Yes.

Q In making that statement, are you using the word “hydraulic” there in the sense -- the ordinary sense of conveying liquid

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through a pipe, rather than referring to the hydraulic method of designing culverts?

A That’s correct.

Q So you are not saying that the manual that you are referring to in Paragraph 9 contained any direction on how to construct a hydraulic fish passage culvert; is that correct?

A That is correct, I am not saying that.

Q And isn’t it also true that the standards for fish passage that the Department of Transportation uses are set by the State of Washington Department of Fisheries and not by the Federal Highway Administration?

A That is correct.

Q Turning to Page 9. On Page 9, you are talking about the inventory of the Department of Transportation culvert sites. And you testified about that some this morning as well. You state there that the inventory is now complete; is that correct?

A That’s correct.

Q Although the inventory is complete, habitat assessments still must be completed on a majority of the department's fish passage barrier culverts; isn't that also correct?

A That's correct.

Q Is it true that about two-thirds of the culverts remain to have habitat assessments on them?

A I believe that is about the number, yes.

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Q Now, you testified earlier this morning about the scoping process. Do you recall that?

A Yes.

Q And you said that a portion of that process involves coming up with estimates of possible project costs. Is that also correct?

A Yes.

Q And isn't it true that those estimates are not done with the same rigor that would be done if the project was being put out to bids, for example?

A I'm not sure about the word "rigor" in that. They're for different purposes. The scoping estimate is a rough estimate. It's based on engineering principles, but it doesn't involve the detailed analysis that would --

Q Right. So it's a rough estimate compared to the actual estimate that an engineer prepares when a project is going to be put out to bid by the State Department of Transportation?

A Yes.

Q And in fact, in the scoping process, those estimates are used primarily for comparison purposes when you're comparing the different possible solutions to the problem that's presented? Isn't that also correct?

A They can be used that way.

Q So if you are considering a retrofit, what's the rough cost of that compared to a rough estimate of the cost of a bridge or a

[Original Page 54]

stream simulation culvert, people come up with numbers for that; is that correct?

A Through the scoping process.

Q Right.

Now, I think you testified that there are some 32 projects in the Scoping Summary Report that's Exhibit 113.

MR. JOHNSEN: Could you put up W-113, please? Did I get the number wrong? It's the one we substituted for 92-J.

THE COURT: Counsel, this might be a good time for our morning recess.

MR. JOHNSEN: Thank you.

THE COURT: We will take our morning recess.

(At this time, a short break was taken.)

By Mr. Johnsen:

Q Mr. Wagner, in front of you on the screen is the second page, the exhibit that we were talking about prior to the break. And this is the page where I believe you testified sets out the barrier culverts that have been scoped for correction in the case area; is that correct?

A Yes. These are projects in the case area where we've completed the scoping process. I can't see the whole document here.

Q That's so we can read the part that is here.

A Okay.

Q You have, I believe, access to a paper copy, if you prefer

[Original Page 59]

A Okay.

Q So 38 of those are shown on the exhibit that's on the screen in front of you; isn't that correct? That's your count?

A Yes.

Q You testified that you felt these 38 were a representative sample of the 800 that remained to be corrected. Do you recall saying that?

A Yes.

Q What did you base that testimony on?

A On my general awareness of these projects and on the discussions we have had about the scoping effort with my staff and with the Department of Fish and Wildlife staff.

Q You have available to you in the course of your work access to the Fish Passage Diversion Screening Inventory Database, do you not?

A We use that database. I don't personally run analyses on that.

Q That's a data base maintained by the State Department of Fisheries that includes all of the

Department of Transportation barrier culverts as well as information on other culverts; isn't that correct?

A Yes. Department of Wish and Wildlife, yes.

Q So when you reached your conclusion that you testified to here in court today in this case, did you consult that database to determine whether in fact these 38 projects are representative

[Original Page 60]

of the remaining 800, as reflected by the data in that database?

A If I'm understanding your question, you're asking me if we looked at that larger database to see if these are reflective of that?

Q Yes.

A I don't believe we've done that analysis.

Q Why not?

A We have been busy with other tasks.

Q Really?

Okay. Well, so you have a general feeling that this is consistent with those 800, but you haven't undertaken any kind of analysis of the data to support your opinion; is that correct?

A These projects represent a range of the stream conditions, streams of different sizes, different locations in the case area, different watersheds reflecting different levels of development, and so this list -- these are the kinds of projects that we're scoping, that are in the process of scoping now that haven't reached completion, and my sense is that these are fairly typical of the types of projects we see.

Q Could you please answer the question that I asked?

A I'm sorry. I guess I need to have that question again.

MR. JOHNSEN: Can the reporter read back the question.

THE COURT: Actually, Counsel, I think he did answer it. Ask him another question.

By Mr. Johnsen:

[Original Page 61]

Q How many of the projects on the list here involve bridges?

A I don't know the number off the top of my head. We've indicated bridge corrections in the description of the proposed solution.

Q Scanning down through it, I see a 200-foot bridge, an 80-foot bridge, a 30-foot bridge.

Is it your opinion that the number of bridges that are reflected in this exhibit is representative of the number of bridges that will be required to address the 800 culverts that remain to be corrected in the case area?

A I'm not sure how to answer that question.

Q Isn't it true that the reason you can't answer it is that you haven't undertaken the analysis that would allow you to answer it?

A Well, a bridge is a method of correction that could be chosen at a number of different locations. A bridge is a specific kind of structure that could be used at a number of spans. And so some of these projects where we say replace culverts with stream sim design, those may in fact be bridge projects as well. We could -- you know, it would be replaced with a bridge structure.

THE COURT: Mr. Wagner, I think the question was a lot simpler than that. There are bridges on this list of 38, right?

THE WITNESS: Yes.

THE COURT: And you said earlier that you thought this list was representative of the 800 that need to be corrected?

[Original Page 62]

THE WITNESS: Yes.

THE COURT: Do you think the numbers of bridges are also representative of that 800, the 38 on here, three bridges, roughly ten percent?

THE WITNESS: It's very possible, yes.

By Mr. Johnsen:

Q You have available to you through the database stream width measurements, do you not?

A Yes.

Q And those stream width measurements are a major factor in deciding the size of a culvert, or a bridge for that matter, that will be used to solve the barrier problem; isn't that also correct?

A Yes.

Q Isn't it true that the database indicates that approximately 80 percent of the current barrier culverts could be addressed with a stream simulation culvert that is no larger than 16 feet in width?

MR. SHAFTEL: Objection. Foundation.

THE COURT: Are you referring to the Fish Passage Diversion Screening Database?

MR. JOHNSEN: Yes.

THE COURT: All right. Overruled.

THE WITNESS: I'm not sure about that. I would need to look at the database.

[Original Page 63]

By Mr. Johnsen:

Q And you have not done that in support of your opinion regarding these culverts; is that correct?

A No, sir.

Q If that is true, if 80 percent of the barrier culverts could be addressed with a stream simulation culvert 16 feet in width or less, is that fact reflected in this exhibit?

A I don't believe so.

Q And in fact, there is a much greater proportion in this exhibit of much larger crossings, is there not?

A Because we are working down the priority index, streams that are larger sizes are going to tend to have a higher priority.

Q And that makes this not representative of the future problem, doesn't it?

A Well, very often it may take a large structure to cross even a small stream, depending on the terrain, the roadway, the depth of roadway fill and other factors that are the realities of the situation on the ground.

Q The projects that were done this past construction season, are they in fact all complete at this point?

A Some are complete. Some are still in their final stages with vegetation work and some other kind of final steps happening to them this fall.

Q Have they passed final inspection?

A They have passed the inspection from our construction

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Q Are you familiar with that culvert?

A A little bit. I haven't been to the site. Since it is not an I-4 project, I wasn't very involved with that.

Q Was it prioritized for correction?

A I believe it has a PI, yes.

Q And is it true that the contract amount for correction of that culvert in this construction season was $546,628?

A I don't know that for a fact.

Q Would you look at Exhibit AT-333, please? Do you recognize this document?

A I believe I saw this for the first time last night.

Q Right. Probably shown to you by Mr. Shaftel, correct?

A Yes.

Q I will represent to you this is a document that I found yesterday on the Department of Transportation's website and provided to Mr. Shaftel, indicating that it's a construction contract report for the Cougar Creek culvert replacement project that you referred to as being completed this year.

This document also shows an engineer's estimate, does it not?

A It does.

Q About $400,000 higher than the actual contract amount?

A That's right.

Q And you testified earlier that the sort of rough estimates that are involved in the scoping reports aren't done with the same level of rigor and analysis as an actual engineer's estimate

[Original Page 68]

when a project goes out to bid.

Do you recall that?

A Yes.

Q The Mosquito Creek project outside the case area but still a culvert that was repaired this season, are you familiar with that one?

A To some degree.

Q That was done under your program?

A Yes.

Q You are not familiar with the actual project?

A I am familiar with the project in general. I haven't been to the site, if that's what you're asking.

Q That's on US 101; is that correct? And construction of that project required closure of US 101 while it was being built; is that correct?

A I am not specifically familiar with that.

Q Where on 101 is it located?

A In Aberdeen.

Q Does the culvert run entirely under US 101?

A I am not specifically familiar with that.

Q The contract for that project was $728,34- -- excuse me, $728,349.25, wasn't it?

A Again, I'm not familiar with those -- with that particular number.

Q This is done under the program you manage; is that correct?

[Original Page 69]

A Yes.

Q Did that contract that you administered seem to be about $730,000?

MR. SHAFTEL: Objection, lack of foundation.

THE COURT: I think he has answered the question, Counsel. He is not particularly familiar with it.

By Mr. Johnsen:

Q Would you look at Exhibit AT-334? This appears to be the construction report for the Mosquito Creek project that we have just been discussing?

A It appears to be.

Q Do you recall that the contract amount when it was actually awarded was substantially lower than the engineer's estimate in this project as well?

MR. SHAFTEL: Objection. Lack of foundation. This witness has not testified that he had any previous knowledge on that issue.

THE COURT: Overruled.

THE WITNESS: I know from talking with my staff that we had a number of projects that came in this season under budget -- or under estimates.

By Mr. Johnsen:

Q Under estimates. In fact, every one of them did?

A Yes.

Q The estimates were uniformly high?

[Original Page 72]

what goes into these numbers.

THE COURT: All right. Which ones are you asking to admit for that limited purpose?

MR. JOHNSEN: 332 through 336.

THE COURT: Is 337 one of these as well?

MR. JOHNSEN: It is.

THE COURT: So through 337?

MR. HOLLOWED: Yes.

THE COURT: For that limited purpose, no objection?

MR. SHAFTEL: Just for the limited purpose of showing the difference between the bid amounts.

THE COURT: I understand. 332 through 337 will be admitted. By Mr. Johnsen:

Q Mr. Wagner, another of the projects was on State Route 122. Would you look at Exhibit 337, please?

Does the title -- the contract title there refer to the project that you were referencing when you said that a Mayfield Lake project was done this year?

A Yes.

Q That is the same project?

A That's correct.

Q Now, for the four projects that were done under the Nickel Program, the two on Tibbetts Creek and the two on Burly Creek, those would fall into the category of we really don't know how

[Original Page 73]

much the culvert aspect of those cost because it was to know as part of the larger project; is that correct?

A That's my understanding, yes.

Q So we have in these Exhibits 332 through 337 both the contract amounts for construction for the projects for this season, where data's available on the cost, and the engineer's estimates for each of those projects; is that correct?

A That appears to be so.

Q I will move on to a different subject. Back to your declaration. On Page 12, as it happened, when you were doing the declaration you said that you received a call on a project – I think it's actually two projects, that you had planned for this year's construction season that caused a delay, and they were located in Poulsbo. Do you recall that?

A I do.

Q Now, the objection that the City of Poulsbo had was that they didn't want the department to be closing a state highway through Poulsbo for construction and requiring traffic to go on other city streets to get around the construction; isn't that correct?

A Yes, that is my understanding.

Q And they were going to actually deny you the use of those other streets for this construction season; isn't that also correct?

A Yes.

[Original Page 92]

number, because for the purposes of the case we have taken out some barriers that were for resident-only fish.

Q But the proportion -- the two-thirds proportion that fixes problems is about the same, if I didn't butcher that question so badly that you couldn't understand it?

Let me try again. About two-thirds of the barrier culverts are located in the case area and about two-thirds of the fixes are in the case area; is that correct?

A Roughly, yes.

Q Now, in terms of the future, based on your testimony today, is it true that you can't -- you're not able to tell the Court by what year the Department of

Transportation plans or intends to have corrected the 800 fish passage barriers that exist in the case area?

A That's correct.

Q And you're not even able to tell the Court the rate at which the Department of Transportation plans or intends to correct those barriers. Is that also correct?

A Well, we put together our ten-year plan to show what our intent is and what we would be prepared to do if funding were available. But ultimately our rate is determined by funding from the legislature, which we don't control.

Q And the ten-year plan is also based on funding that you know or anticipate at this point; isn't that correct?

A Well, our ten-year plan is identifying corrections that we

[Original Page 93]

think could be accomplished in that timeframe, ones that we think would be appropriate to be working on and are staged to be ready for delivery on the schedule that we're laying out there.

Q And those ten-year plans appear in the annual progress reports each year, don't they?

A They appear -- in 2006, we were still using a six-year plan. And subsequent to that, we expanded the program to a ten-year plan.

Q But the current ones have a ten-year plan in them?

A Yes.

Q Beyond that, you don't know what the rate would be; is that correct?

A Depends on funding.

Q And even within the ten years, it still depends on funding, doesn't it?

A Yes.

MR. JOHNSEN: Thank you, Mr. Wagner.

THE COURT: Redirect for Mr. Wagner?

REDIRECT EXAMINATION

By Mr. Shaftel:

Q Mr. Wagner, we've done quite a bit of talking about the ten-year plan, but I don't believe you've actually shown the Court what we're talking about.

Can you look at the monitor there and tell me what is this on the monitor?

[Original Page 106]

A We do.

Q What is that system?

A We contract with the Department of Fish and Wildlife to do annual fishway inspections, and those are reported on as part of our annual report.

Q And why does it have that system in place?

A It's important to keep after those, because they do require maintenance, they do require ongoing monitoring.

Q In fact, of the 49 mentioned, aren't a number of those, or a great deal of those, the fishways that you're monitoring over time?

A Yes.

Q I would like to turn your attention to Page 5 of your declaration, Paragraph 9. I believe you were asked a question about what you meant in this paragraph here relating to the Federal Highway Administration HEC 10 document and whether or not the DOT in fact looks to the Federal Highway Administration to provide fish passage standards or whether or not it looks to state guidelines.

Do you remember that question?

A I do.

Q What was your intent by making a mention of HEC 10 in this paragraph?

A In terms of engineering guidance, Washington State DOT and other DOTs do look to the federal highways for basic guidance for

[Original Page 107]

engineering design. And my point in bringing this up was that this is really, to date, the only manual or direction that's been provided for how to design culverts from the Federal Highway Administration.

The focus has been on design for hydraulic capacity not just to kind of carry water. And in my declaration, I mention that just in the last couple of years, the Federal Highway Administration has issued a synthesis document that's sort of an analysis of the state of the art for fish passage but has yet to put out a manual or a direction on how to incorporate that into hydraulic design.

Q And so did the Department of Transportation historically rely on the HEC 10 document?

A Yes.

Q And that document didn't mention anything on whether or not those culverts that were being installed by the Department of Transportation, consistent with those guidelines, in fact metfish passage standards; is that correct?

MR. JOHNSEN: Object to the form of the question. It's leading.

MR. SHAFTEL: It's redirect.

THE COURT: The objection is sustained.

By Mr. Shaftel:

Q Did the department -- I'm sorry. Did the Federal Highway Administration ever inform the Department of Transportation that

[Original Page 108]

HEC 10 standards did not, in some cases, allow for fish passage, to your knowledge?

A Not to my knowledge.

Q You were asked a number of questions about projects that are 16 feet or less in width size and projects that have yet to be performed that are still on the list.

Do you remember that set of questions?

A Yes.

Q There was a representation made to you that assumed that 80 percent of the culverts in fact could be addressed with a 16-foot width or less number.

Do you remember that question?

A I remember that question.

Q My question to follow up on that is whether or not the width of a culvert is the only driver of costs.

A It's definitely not the only driver of costs. There are similarly significant cost factors related to the depth of fill that's over the culvert, to the length of the culvert itself, to the traffic on the roadway, real estate, right-of-way issues, access issues, all can be significant cost factors.

Q Can risk be a cost factor? Do you know what I mean by "risk"?

A Yes.

Q What do you understand me to mean?

A The chance of something in the project not going as planned,

[Original Page 124]

I think the earlier question was about the general concept of fish passage corrections being added to safety and mobility projects as a means of efficiently correcting barriers.

Q So in your mind, it is added if it is required by state law but not something the department would otherwise do; is that correct?

A Added to the scope of the project.

MR. JOHNSEN: Thank you.

THE COURT: Do you feel a little bit Matt Hasselbeck up there?

Mr. Wagner, you may step down.

MR. MONSON: Your Honor, Peter Monson. I think I have just a couple questions.

THE COURT: Oh, great. All right. Are you ready now?

MR. MONSON: I will be brief. Yes.

RECROSS-EXAMINATION

By Mr. Monson:

Q Good afternoon, Mr. Wagner. I'm Peter Monson. I represent the United States in this case.

There was a couple of questions that you were asked on redirect regarding the HEC 10 standards, or a guidance document. Do you recall those --

A I do.

Q -- that your counsel asked you?

The HEC 10 manual is a hydraulic manual, is it not?

[Original Page 125]

A Yes. "Hydraulic engineering circular" is the acronym.

Q Thank you. Does it have any statements in there regarding the design criteria for fish passage?

A Not to my knowledge.

Q You indicated both on redirect and in your written testimony that "At no time has FHWA notified WSDOT that the federal design standards failed to provide fish passage for the culverts design pursuant to the standards might violate treaty fishing rights." Do you recall writing that statement?

A I do.

Q Has the FHWA ever notified WSDOT that the federal design standards were sufficient to meet the fish passage?

A Not to my knowledge.

Q Is there anything in the HEC 10 circular that precludes the State from modifying the design standards to accommodate local conditions, such as fish passage?

A Not that I'm aware of.

MR. MONSON: No further questions. Thank you.

THE WITNESS: Thank you.

THE COURT: Mr. Shaftel, anything else from the State based on the questions from the government?

MR. SHAFTEL: No questions.

THE COURT: Mr. Wagner, you may step down. Thank you.

Counsel, let's take our break.

(At this time, a short break was taken.)

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removing the culverts. Is it your opinion that you have to know the actual number of fish increase to know what you're doing has a benefit to fish?

A No, I don't think you do.

Q Has parks completed their inventory of culverts?

A No, I don't believe they have.

Q Did they used to have a contract with WDFW and it terminated?

A Yes.

Q Do you know anything about the costs of different culvert designs, say between hydraulic and stream simulation?

A Only in a general sense.

Q In terms of a culvert project, I have been told often the highest cost involved manpower, the diversion of the roads, and other types of costs would essentially be constant between two types of culvert fixes.

Is that your understanding?

A If you are getting to the size of the culvert, it is not the largest influence in the cost of the project, that can be true, yes.

Q In fact, you testified earlier if you're doing an open cut, there really isn't much difference between stream simulation and the cost of a hydraulic culvert; is that correct?

A I don't believe so, no.

Q Because the idea is if you're digging up the road anyway and you're diverting the traffic anyway, that this is just a

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difference in size of the culvert; is that correct?

A There's a small monetary difference, but I think relative to the overall project cost, it would be small.

Q I believe you heard Mr. Wagner testify earlier about WDFW monitoring fish passage barriers; is that correct?

A That's correct.

Q Isn't it just I-4 projects that are monitored currently?

A That is correct. We only do a compliance inspection on those projects that were constructed using other funding sources. We do not do any followup monitoring other than those that fall within the category of a fishway retrofit. Those, we will inspect annually.

Q Because fishways have lots of problems, right?

A That's correct.

Q So you can't just walk away from a fishway?

A No, you can't.

Q But for the rest of the culverts, nobody's going out to look at them to see if they're currently complying with fish passage?

A No. Nobody from WDFW.

Q Are you familiar with the scoping work for the Highway 3 crossing at the mouth of Chico Creek in Kitsap?

A A little bit.

Q Are you aware that this is a pretty expensive project, around the range of $31 million?

A Yes.

[Original Page 161]

Q Is it a good project?

A Yes, it is.

Q And why is it a good project?

A There's a significant amount of habitat upstream, and Chico Creek also is a significant Chum Salmon producer in that area.

Q So from your perspective, it is high cost but well worth it?

A It's a good project, yes.

Q Are you responsible for the collection of data regarding DOT culverts in the case area?

A Ultimately, yes.

Q Basically it's done by field crews?

A Yes.

Q And one of the elements that the field crews measure is lineal salmon habitat upstream?

A Lineal gain upstream.

Q And they measure spawning area?

A Yes.

Q And rearing area?

A Yes.

Q And they put this all into a database called the FPDSI; is that correct?

A That's correct.

Q And you testified that WDFW calculated PI values for some of the culvert sites in the case area?

A Yes.

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[Original Page 9]

asked if it's reasonable to rely on certain parts of the document. I'd like to know what he thinks about the -- if he thinks the document is acceptable.

Can you go ahead and put up 156?

THE COURT: You may proceed, Ms. Rasmussen.

RECROSS-EXAMINATION

By Ms. Rasmussen:

Q Mr. Barber, Ms. Woods asked you about numerous portions, including the cost estimate that was done in 1997 and the number of culverts and a couple of other items that she asked you if it was reasonable to rely on, and you said no.

Is that the extent of the parts of the document which are not reasonable to rely on?

A I think there are other components of it that could be questionable.

Q Is it questionable, the statement in the first paragraph, that "Fish need habitat, but if they cannot reach spawning and rearing areas, then the full potential of the habitat is not achieved and depressed, and even healthy fish stocks decline to levels that cannot support utilization objectives and even levels of extinction"?

A I think that statement's correct.

Q And No. 2, that state law requires fish passage, is that no longer correct?

A No, that is still correct.

[Original Page 10]

Q And you didn't state any opinion about the miles of road crossings that were estimated, did you?

A No, I didn't.

Q Is it still true there is a need to accelerate fish passage corrections?

A I believe so.

MS. RASMUSSEN: No further questions. Thank you.

THE COURT: I believe you may step down. Thank you.

THE WITNESS: Thank you.

THE COURT: Do we have a new witness?

MS. RASMUSSEN: Your Honor, I believe we have to deal with the rest of the objection back-and-forth of Ms. Woods and I on AT-236.

THE COURT: Let's deal with AT-236. That's the Fish Passage Inventory and Corrections Status Summary.

MS. WOODS: Your Honor, we maintain the objection to that document. As indicated in Mr. Barber's answer, that document was prepared for litigation. It was not prepared by an agency employee within the scope of his normal duties. It was prepared for litigation.

THE COURT: Ms. Rasmussen?

MS. RASMUSSEN: Yes, your Honor. This is essentially the quintessential admission. They created something and now they no longer like what they created, and so they want to take it back. But under the -- it's not hearsay under 802 (d)(2)(b)

[Original Page 115]

want to make that stream simulate the outside of the stream when you're doing the culvert. But in terms of their size, would it be fair to say that a stream simulation culvert would, in the main, be wider than a no-slope culvert?

A Are you talking about the span or the width of the bed?

Q The width of the culvert. The culvert would, as I understand the formula, would create a culvert slightly wider than the bankful width with respect to a stream simulation. Is that true?

A Yes, although that may not be true in terms of the culvert span. But we will make it simple, and I'll say yes.

Q Good. I appreciate your help on that.

My question goes one more, though. If I'm going to install both of those and I'm going to have to dig a hole to put it in, and I put a coffer dam up so the water doesn't come through when I'm working on it, and I've got to buy flaggers, and I've got to buy -- whatever I have to buy to make this happen, there really isn't much difference in the cost between a stream simulation and a no-slope when you decide to install one or the other?

A In a public works project like you'd find on a public road, the cost of the culvert is relatively small compared to the overall project costs. Now, on a forest road, that is not the case any longer.

Q In terms of Department of Transportation, which have public work highway kinds of projects?

A That's exactly right. The guardrail probably costs more than

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the culvert does.

Q Thank you.

A I shouldn't have said that.

Q I think I understand. It's relatively small.

A Yeah. There are all these other elements into these things which are very costly, and traffic control being one of them.

Q You developed stream simulation when it wasn't there before?

A Right.

Q Is it fair to say that culvert design methodology, science, is evolving?

A Yeah.

Q And you would expect, then, that some day, sooner or later, somebody might have an improvement to stream simulation?

A They might.

Q It may be you?

A It may be me.

Q I understand you're doing some studies right now?

A That's right.

Q So that applying some sort of an adaptive management or continuing to look at the process would make sense from a scientific point of view?

A Well, if my experience with the forest and fish adaptive management program is any example, I would say no.

Q Let's leave forest and fish out for a moment and just look at the concept of continuing to look at the science that exists

[Original Page 122]

methods.

Q Right. I put it as more of illustrative. I didn't --

A Yeah. What we're showing is this continuum, just on the basis of width, between the smallest, least expensive, but having the greatest ecological effects, to one which has the greatest benefit, showing that continuum.

MR. STAY: And again, a second time, thank you very much. I have nothing further, your Honor. Mr. Monson has a few questions.

MR. MONSON: Thank you, your Honor.

RECROSS-EXAMINATION

By Mr. Monson:

Q Mr. Barnard, I'm Peter Monson. You last saw me probably on a little black box on a speak phone at your deposition. It's a pleasure to meet you in person.

I just have a very few questions. I can't help but comment that your enthusiasm for the stream simulation method is very infectious.

A Well, one of the federal agencies, the Forest Service, has written an absolutely stunning guidance manual on stream simulation.

Q Well, thank you. You just answered my next question. I appreciate that.

A I was one of the major reviewers for that guidance manual.

[Original Page 123]

Q Excellent.

And the Forest Service has a slightly different technical approach, does it not?

A Oh, that. Well, we're headed to the same place. We're headed to simulating natural stream conditions inside the culvert. We're both going to the same place, but they get there with a level of rigor which is way beyond what we require.

Q That's good to know. Thank you.

Now, the National Marine Fisheries Service has also indicated a preference for the stream simulation methodology, right?

A Yes.

Q And they have an approach that's also ended towards the same goal. They calculate the --

A It's headed towards the same goal, although they use – I want to remember this correctly. They use a simple factor to relate the bankful channel width to the culvert bed width. I believe it's 1.3.

Q From a fish's perspective, it probably looks about the same?

A Well, actually, one of the problems with it -- do you want to know what the problems with it are? Do you want me to go into this?

Q I don't really want to get into too much detail. I wasn't really looking. I was just wanting to make a point that they have developed similar methodology.

A They have a criteria as well.

[Original Page 127]

fish passage and culverts called -- I think it's called HEC 26. I just read a final draft of it a couple of weeks ago.

Q Does the Federal Highway Administration also indicate a preference for stream simulation culverts?

A Well, actually, the draft I read of HEC 26, they recommend a culvert design method based on sediment stability.

It was very disappointing. I read the initial draft of this. They are adamant. It's sort of an engineering-based design. It is kind of like -- it's basically kind of a velocity sort of design based on sediment stability.

Q From a fish passage perspective, you still continue to believe that stream simulation is the best?

A Oh, yeah.

MR. MONSON: I have no further questions. Thank you.

THE COURT: Any redirect, Ms. Woods?

MS. WOODS: No redirect, your Honor.

THE COURT: Mr. Barnard, before you step down. I appreciate your enthusiasm for all this as well.

Thank you. I have a question that may not make a lot of sense. Maybe it's my lack of understanding here.

THE WITNESS: It's a complicated business.

THE COURT: I assume that most of the streams that we're talking about that have these barriers drain into either Puget Sound or the Pacific Ocean, correct?

THE WITNESS: You're talking about the case area?

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thing is to have a comprehensive look of integrating all those Hs and the processes connected to them into one particular way of looking at fingerprinting the watersheds. In other words, how do those comprehensive uses fit together to give you the best bang for the buck for salmon recovery.

Integrating into the watersheds would allow you to fingerprint which part of the H needs to be done at which particular point in time, and how they all fit together in the watersheds will become much clearer than they are right now. In some cases, you have people competing for funds because they want to address one H over the other H, and there just isn't that much money to go around to do that.

In my particular view, and the co-managers in the state of Washington have been trying to do this, we just haven't had the money and the personnel to get it done, given all our other responsibilities, is to begin to form an integrated look to what needs to be done in each one of the watersheds so we have a comprehensive plan of moving forward. That would be the starting point, and then you could take your bushel of money and begin to apply it to those particular priority needs.

That would be, if I were ruler of the world for ten minutes, my view of it.

THE COURT: In your opinion, that is not occurring right now?

THE WITNESS: In my opinion, that is not occurring to

[Original Page 86]

the degree that it needs to occur. That's correct. It has not been done on a systematic basis.

THE COURT: And when we talk about that integrated look, I'm sure you are including the tribes as well?

THE WITNESS: Absolutely. Oh, absolutely. Again, we've been trying to do this. We just haven't been able to get to it.

THE COURT: Ms. Woods?

MS. WOODS: I have no further questions at this time, your Honor.

THE COURT: Cross-examination, Mr. Stay?

MR. STAY: Thank you very much, your Honor.

CROSS-EXAMINATION

By Mr. Stay:

Q Nice to see you, Dr. Koenings.

A It's a pleasure to be here. We've done this before.

Q Haven't we, though? You're not an engineer, are you, Dr. Koenings?

A I am not.

Q Nor are you a hydrologist?

A I am not.

Q So you're not an expert in the design or operation of culverts?

A I am not.

Q As I understand it, there is -- we have limited factor assessments now in all of the watersheds?

[Original Page 104]

And the State may call their next witness.

MS. WOODS: Your Honor, the State will call Brian Benson.

THE COURT: Mr. Benson, I'll have you raise your right hand and be sworn.

Whereupon,

BRIAN BENSON

Called as a witness, having been first duly sworn, was examined and testified as follows:

THE CLERK: Please state your full name and spell your last name for the record.

THE WITNESS: Brian Benson, B-E-N-S-O-N.

THE COURT: Mr. Benson, there's water on your left if you need it.

You may inquire, Ms. Woods.

DIRECT EXAMINATION

By Ms. Woods:

Q Good afternoon, Mr. Benson.

A Good afternoon.

Q Mr. Benson, where do you work?

A I work for the Washington Department of Fish and Wildlife.

Q How long have you worked for the Washington Department of Fish and Wildlife?

[Original Page 105]

A Almost 29 years.

Q What are your current job responsibilities?

A Currently I'm an information technology specialist in the science division, which is part of the habitat program. My job responsibilities, I manage two fairly large natural resource databases. It involves design, construction, maintenance, updating, modifications. I'm responsible for creating and maintaining the GIS products that come out of those databases.

Q How long have you been doing that type of work?

A Probably started in the early 90s.

Q Would you please describe your educational background?

A I have a Bachelor of Science in marine resources from Huxley College of Environmental Studies at Western Washington University.

Q Do you have experience as a fish biologist?

A I have held that position, yes.

Q With the Washington Department of Fish and Wildlife?

A That's correct.

Q Is that before you began the database work that you've been doing now for a while?

A Yes, and kind of at the same time as well.

Q Mr. Benson, were you in the courtroom during the testimony of Tyson Waldo?

A Yes, I was.

Q Do you recall him using the acronym FPDSI?

[Original Page 106]

A Yes, I do.

Q What does FPDSI stand for?

A Fish Passage and Diversion Screening Inventory.

Q Is that a database?

A That is a database.

Q Who developed the Fish Passage and Diversion Screening Inventory Database?

A I did.

Q Why did you choose the title "Fish Passage and Diversion Screening Inventory"?

A Well, for one, it's reflective of the contents of the database. Also, it is hard to pronounce. Most database developers like to come up with names that have catchy acronyms, and I don't particularly care for that.

Q Is it okay if I use it -- if I call it the FPDSI?

A Yes.

Q Would you please describe the history of the FPDSI?

A Well, the predecessors to the FPDSI probably originated in the late 1980s and early 1990s. I started with the SHEAR program about 1996, and there were several independent databases being used to keep track of the various fish passage inventories and fishway inspection projects. There was just an ad hoc kind of table, essentially, that contained barrier information.

After I joined the division, we started the Thurston County inventory, which had its own database, and then the Jefferson

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County inventory, again, had a separate database. So in about ‘97, ‘98 when we started working on the manual, we decided to create a database to support the manual, and as part of that process, we would incorporate all the other independent databases into it. That database became known as SHEAR base, and it’s undergone several iterations over the years and finally ended up being the FPDSI.

Q When you say “the manual,” what are you talking about?

A That’s the Fish Passage Barrier Assessment Manual.

Q Are you the person who currently maintains the FPDSI?

A Yes, I am.

Q What kinds of data does the FPDSI contain?

A It contains information on fish passage structures. It contains some information on surface water diversions. Relative to the fish passage information, it's got locational data. It's got specific descriptors of the various types of fish passage structures, whether they be culverts, dams, things like that, the habitat information, and the priority index information.

Q Does the data change over time?

A It changes on virtually a daily basis.

Q And why is that?

A Well, it's an active database. We have a lot of work going on with the DOT inventory crews. They come in and update and add data weekly. I add data on a fairly regular basis from inventory information coming in from non WDFW sources.

[Original Page 108]

Q About how many records for fish passage structures does the FPDSI have today?

A It has over 36,000.

Q About how many of those are human-made fish passage barriers?

A Around 11,500.

Q Of those 11,500, about what proportion are state owned?

A I guess it's just under 25 percent.

Q Does the FPDSI have records for every fish passage barrier in the state of Washington?

A It does not.

Q Why not?

A Well, several reasons. There are a number of large data sets that we don't have. We don't have DNR's data set incorporated. We don't have the Forest Service data set. We don't have the large commercial forest landowners information. There's just a lot of private and local governmental culverts out there that have not been assessed and inventoried.

Q Are the inventories for Washington State Department of Transportation culverts complete?

A I believe they are.

Q Are the inventories for Washington Department of Fish and Wildlife culverts complete in the case area?

A I believe so.

Q Is the inventory for state parks culverts complete?

A Not to my knowledge.

[Original page 109]

Q Has any complete inventory of non state culverts been done, to your knowledge?

A No.

[Original Page 115]

remaining pages in the exhibit and tell me if the remaining pages are all similar to Page 3 displayed on the screen.

A Yes, they are.

Q Do they display a similar type of information?

A Yes, they do.

Q Did you prepare any maps that illustrate non state-owned passage barriers upstream and downstream of the culverts that Tyson Waldo used for his analysis?

A Yes, I did.

MS. WOODS: Your Honor, I will be attempting to lay the foundation for 14 maps. I hope that we can streamline this a little bit.

THE COURT: Can you tell me what exhibit number they start with, Counsel?

MS. WOODS: 119.

By Ms. Woods:

Q Mr. Benson, are those maps in the same binder that you've already got, I hope?

A Yes.

Q I have up on the screen Exhibit W-119. Mr. Benson, did you prepare this exhibit?

A Yes, I did.

Q What is it?

A This is a map of Chico Creek, displaying the upstream and downstream barriers associated with a barrier taken from the list

[Original Page 123]

A Yes.

Q But your point isn't that the State doesn't have to fix theirs; it's just that there's a lot of other work that has to be done, right?

A That's correct.

Q And in order to achieve the benefit -- say the counties were to come in and really go out and fix that 1,370 barrier culverts, it wouldn't realize its full benefit, right, unless the State fixed their 315?

A That's correct.

Q And I believe in your Exhibit 88-C, you say there's 42 barriers with no other barrier in the watershed. And when I look at 133 and sort of go through, there's a couple of pages past this. I went through the columns of the grand total and looked for zeros, and I found about 77 of them.

Would that be my mistake or a change in the data set?

A I believe there may have been some qualifiers on the data that were used in the other table. I think there was a minimum of 200 lineal meters of habitat required upstream that would have to be included on that. This table here, that filter is not in place, so some of these that you see here may not have that 200 meters of habitat associated with them.

Q While we're on this page, I want you to take a look at site 102 L 062, where it says there's 140 other culverts in the watershed.

[Original Page 124]

That's Little Bear Creek, isn't it, one of the examples that Mr. Tomisser used in opening statements?

A I believe that's correct.

Q It is kind of an outlier, isn't it?

A It's a very high number.

Q In fact, it's the only culvert of the 315 that has 81 more sites associated than any other, is that correct? In the ballpark. I'll say I counted.

A Can you repeat that, please?

Q Little Bear Creek, the example used by Mr. Tomisser in his opening to illustrate his problem, is such an outlier, in fact, doesn't it have about 80 more sites associated than any other culvert in the examples? If you want to verify, you can scroll through -- go ahead and circle that first page where the 140 is. I'll attest to you that I verified that that was in fact the site ID for Little Bear Creek.

I don't find anything on the grand total that's anywhere near that particular example that Mr. Tomisser chose to use in his opening. Do you?

A No, you don't.

Q And in fact, you use this example because Counsel asked you to, right?

A That's correct.

Q Does Little Bear Creek, to your knowledge, have a high PI or a low PI?

[Original Page 137]

I'm going admit AT-323 and AT-324.

By Ms. Rasmussen:

Q I guess I'll have to use this one.

You created this spreadsheet; is that correct?

A Yes, I did.

Q And if you wanted to know -- I attested to you that the tribes have proposed in the pretrial order a resolution whereby they're asking DOT to fix 90 percent of the habitat.

Would there be a way to find out, based on this analysis, what 90 percent of the habitat -- how many culverts that would mean?

A Which habitat metric are you referring to?

Q Well, if I understand correctly, this worksheet has "habitat gain" on it. It has "lineal gain" in Column M.

So you have "lineal gain" in column M, and that lineal gain is associated with fixing certain culverts. And have you another column that's the cumulative percentage of habitat? Is that the one in Column 0?

A "Cumulative percentage of lineal gain."

Q "Cumulative percentage of lineal gain." Well, how would you find out 90 percent? Since it is your spreadsheet, I won't embarrass myself by doing it for you.

A Well, you would go down the column until you reach the 90 percent value. That would correspond with a line that would give you the number of culverts associated with that value.

[Original Page 138]

Q I believe we've found the line. Can you scroll over and tell me how many culverts that would be?

Sorry, your Honor, it's a little different than the worksheet.

Let's go back to 323. Is there a way to find out what line culvert this is? When we printed it out, it did a numerical value for which culvert it was.

A I think you're corresponding to a value of 577 there.

Q Okay. So the sort number is that it would take, according to this worksheet, 577 of the 807 culverts with over 200 meters of habitat to get 90 percent of the habitat gain; is that correct?

A Based on the information that's in here. Again, you're mixing estimated with real data here, so you can't say for sure that that is exactly what you're going to end up with.

Q And when you say "estimated," you're referring to the SPI, not the EDT analysis which you referred to before as the non field verified?

A EDT is also an estimate.

Q Okay. And you use EDT frequently, correct?

A We don't use it that often anymore.

Q Does it amount to a large percent of the data or just a small percentage?

A I would say a smaller percent.

Q So your caveat here is that the SPI is based on this GIS exercise, so that it's not absolutely 577 exactly, which would

[Original Page 139]

yield 90 percent habitat gain; is that correct?

A That's correct.

Q And in order to know that for sure, you'd probably have to do these habitat assessments that the tribes are interested in having the department complete; is that correct?

A That's correct.

Q All right. But this would give you at least some sort of idea that the remedy that the tribes are seeking isn't all 807 of the culverts, should the department complete habitat surveys.

A That's correct.

Q And that would impact the total number that would need to be fixed at an accelerated schedule; is that correct?

A I believe so.

Q So unfortunately for me, I have another spreadsheet I'd like to ask you about, 168.

Do you know what the anadromous all PI 92 worksheet might be?

A Yes, I do.

Q Do you recognize this?

A I do.

Q And did you do this?

A Yes, I did.

Q And what does it represent?

A It's essentially the same as the previous spreadsheet; however – well, it's not essentially the same. It's the same site, same order. It doesn't have the calculated fields, the

[Original Page 143]

Q And you don't know why it has such a high PI?

A Well, there are many factors that go into the PI. It could be the amount of habitat, the potential habitat gain. It could be the number of species that stand to benefit.

Q If I wanted to know the potential lineal gain from Little Bear Creek, what would I do?

A Potential lineal gain?

Q Yeah.

A Well, I would just follow the spreadsheet over to right there where it says "potential lineal gain."

Q And you don't recall if that's somewhere near 18 miles of habitat?

A I'd have to do the math. I don't report my stuff in miles typically.

Q But the examples -- suffice it to say that the examples of the maps you used, and I don't mean to beat a dead horse, were not randomly selected; they were selected because they had a high number of barriers, right? It wasn't a statistically valid sampling technique?

A It was -- yeah. The sites were not randomly selected.

Q The purpose was to drag out a bunch of examples where a lot of people were shirking; isn't that correct?

MS. WOODS: Objection as to form, your Honor.

MS. RASMUSSEN: Sorry. I've been reading "Horton Hears a Who."

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[Original Page 27]

CROSS-EXAMINATION

BY MR. SLEDD:

Q Good morning, Mr. Moore. Mr. Tomisser reminded you of when we met, which was June 22nd, I believe, at your deposition?

A Yes.

Q I want to start out by going a little bit through your qualifications in the preparation of your declaration. I will not ask about your biological background.

Before you went to work for OFM in 1986, you did not have any experience working with state transportation budgets, did you?

A No.

Q And you worked as a budget analyst with transportation budgets for a few years, but that ended in 1991, I believe you said?

A Correct. Four years.

Q About 20 years ago?

A Correct.

Q When you were a budget analyst for Senate Ways and Means in 1983 and 1984, you did not work with the transportation budget?

A No.

Q And when you were with the House Appropriations Committee from 1991 to 2000, you did not work with the transportation

[Original Page 40]

budget and about 3 percent on the transportation capital?

A I think you're talking about the amount that the budget went down versus the amount that the revenue went down.

Q Oh, okay. But the general conclusion was that the general fund budget has been worse off than the state transportation budget?

A In terms of percentages, yes.

Q In terms of percentages of revenue and in terms of percentages of the expenditures that had to be cut as well?

A Right.

Q They go hand-in-hand?

A Correct.

Q I'd like to talk a little bit more with you about the general fund budget as compared to the transportation budget. If you're talking about funding for the Department of Transportation highway construction spending, it's the transportation budget that you're talking about, right, not the general fund budget?

A Correct.

Q The state general fund budget actually isn't that relevant to the DOT highway construction budget?

A No.

Q Because they're two separate budgets, two separate

appropriation bills, and they have separate revenue sources?

A Correct.

[Original Page 41]

Q The general fund is basically you've got sales taxes, B&O, property tax. And on the transportation side, you've got license fees, fuel tax, correct?

A Correct.

Q So really, the only way the general fund budget would be relevant to highway construction program is if somebody wanted to take money from the general fund budget and use it to augment transportation spending, correct?

A For transportation-related uses, yes.

Q And are you aware of that ever having been done, where general fund money was taken and put into highway construction spending in the state of Washington?

A I'm not aware on the highway construction side. I think it happened for the ferry system at one point.

Q Once or twice in the 1990s?

A Yeah. In the mid 90s, yeah.

Q What I call the natural resource agencies and the landowning natural resource agencies, the DFW, Department of Fish and Wildlife, state parks, and the Department of Natural Resources, are they funded through the transportation budget?

A I think some of them receive a small amount of transportation funding if they have -- I think there's some road programs where Fish and Wildlife might receive some money. I'm not certain of others, but I think there is some limited transportation-related money to deal with roads

[Original Page 75]

MR. TOMISSER: Thank you. Nothing further, Your Honor.

THE COURT: Mr. Moore, thank you very much. You may step down, sir.

THE WITNESS: Thank you.

THE COURT: Nobody asked him what he thought of Tim Eynman while he was on the stand.

You may call your next witness.

MR. TOMISSER: Before I do that, Your Honor, if I might approach and hand the clerk the amended G before we lose track.

THE COURT: Thank you.

MR. TOMISSER: The state calls Mr. Jeff Carpenter.

THE COURT: Good morning, Mr. Carpenter. Raise your right hand to be sworn:

JEFF CARPENTER, HAVING BEEN FIRST DULY SWORN, TESTIFIED AS FOLLOWS:

THE CLERK: Could you please state your name for the record and spell your last name for our court reporter.

THE WITNESS: Jeff Carpenter, C-a-r-p-e-n-t-e-r.

THE COURT: You may inquire.

DIRECT EXAMINATION

BY MR. TOMISSER:

Q Good morning, Mr. Carpenter. Thanks for coming back. To get started here, could you describe for the court briefly

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both stream and anything carrying water across our highway.

And some of the measurement criteria is keeping it free of debris, routine inspection and cleaning, removal of beaver dams, should they be an issue for us. So on this, those are the criteria. And to get a C, we need 5 to 10 percent of our culverts, effectively, having issues. Anything more than that, we would be less than C; anything better, we'd be better than that particular grade. So each one of these elements has a similar measurement set.

Q So this broad category 282 for culvert, is that more culverts than just fish-bearing culverts?

A Yes. It's all culverts across the highway.

Q And so then when we look over the headings across the top of the sheet, do those refer to the various regional areas within the Department of Transportation around the state?

A Yes. Those are the regions that we designate in terms of our core response and how we manage our agency.

Q And so if we look at the northwest region and then read the grades, go down, what does that tell us? How do we read those grades in comparison to the target set by the legislature?

A Okay. So the northwest received an F-plus on culverts. And I had to ask because I didn't know what the plus was either. The plus -- effectively, anything over 20 percent blockage receives a grade of F. So if it's 21 percent or 81

[Original Page 119]

passable would either be an improvement or a preservation project; is that correct?

A Correct.

Q So those would come out of the bottom half, the capital half of this budget?

A Uh-huh. Yes.

Q All right. Well, back to these budget numbers. The $20.3 million that the legislature apparently has appropriated for the culverts for this biennium, that's the highest amount that's ever been appropriated for that purpose, isn't it?

A I believe so.

Q And compared to the overall budget of the department, that -- well, let's see. How would we do that math? One percent of a billion dollars is ten million dollars; is that correct?

A Yes.

Q So maybe the simplest way to --

THE COURT: This is why I became a lawyer.

MR. JOHNSEN: This is exactly why I became a lawyer. I was planning on dealing with billions all the time.

Q (By Mr. Johnsen) Basically what we're going to do here is figure out what percentage of the overall budget the culvert appropriation consists of. You would take 20.3 million, or figure 20.3, and divide it by whatever the total budget is, either 5.271 -- or excuse me, 5,271 or 5,800; is that correct?

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Q But it's not -- well, let me ask this question. Have you compared the characteristics of the projects on that list, the scoping list, with the list of 800 projects that remain to be done in the case area for the washed out fish passage culverts?

A No.

Q So you don't know whether the scoping list is in any way representative of the number of projects that remain to be done?

A No, not with what certainty.

Q Well, you have no basis for making a comparison because you haven't done a comparison; is that correct?

A All estimating we do is based on risk. And if we were asked by the legislature to give us a price, we would use the scoping list as the best available document to extrapolate from there, acknowledging that there could be variations in the estimates, and this is the best we have at that time.

Q But you've not been asked by the legislature to give an estimate of the -- no, that's okay. Never mind.

The center line miles graph, or whatever that was that was shown, the exhibit that was admitted earlier today, I take it that the center line on Interstate 5 is actually not a line on the road at all; it's just a length of the road from Vancouver to Blaine. Is that correct?

A There's no line in the road, no, sir. It's theoretic.

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THE CLERK: Would you please state your name for the record and spell your last name.

THE WITNESS: My name is Philip Roni. Last name is spelled R-o-n-i.

DIRECT EXAMINATION

BY MR. MONSON:

Q Good afternoon, Dr. Roni. Where are you employed?

A I'm employed at the Northwest Fisheries Science Center of NOAA Fisheries in Seattle, Washington.

Q What's your position there?

A I'm a research scientist and the watershed program manager.

Q What are your duties, first as a research scientist?

A Developing proposals, overseeing research, analyzing data, and publishing results of those studies.

Q What are your duties, generally speaking, as the watershed program manager?

A I lead up a program of about 25 research scientists. We do research on primarily freshwater and stream habitat for salmon. And so my duties there are I directly supervise about four people, and then there's three research teams, one that focuses on restoration effectiveness, one that focuses on ecosystem processes, and one that focuses on landscape ecology and recovery science. I'm also responsible for the budgeting for the entire program.

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Q When did you first begin working for the National Oceanic and Atmospheric Administration, which I'll often call NOAA?

A I began working for them in 1995.

Q And what position have you held at NOAA since you began in 1995?

A In 1995, I was hired as a research scientist to start up a freshwater habitat research team. And so initially – to lead up a research team. And also I served as the representative on the research and monitoring committee for the Northwest Forest Plan.

Then I was the team leader for the Instream Restoration Effectiveness Team, and then we became the watershed program in the year -- well, I became the manager of the watershed program about the year 2000.

Q Have you ever worked for the Washington Department of Fisheries or its successor, Department of Fish and Wildlife?

A Yes. In graduate school in 1990, I was actually – part of my research was funded by the Department of Fisheries, and I did some work for them to fund my research. I am a biologist too. But I was stationed at the University of Washington.

In 19- -- I guess I can look at my CV. I think in '93 or '94, I worked for the Department of Fisheries, which then became the Department of Fish and Wildlife, at the Brennon Shellfish Lab on the Hood Canal.

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your participation in these various groups, as well as your publications, would you consider yourself to be an expert in salmon habitat restoration and salmon recovery?

A Yes. Sorry, it feels a little odd to say that.

MR. MONSON: Your Honor, I move to qualify Dr. Roni as an expert under Rule 702.

THE COURT: Any objection?

MR. FERESTER: No objection, Your Honor.

Q (By Mr. Monson) Dr. Roni, were you present in the courtroom and did you hear Dr. Koenings' testimony regarding the four Hs?

A Yes, I did.

Q And those are habitat, hatchery, harvest and hydropower, right?

A Yes.

Q Do you have an opinion as to which of the four H's is the most important to salmon recovery in Western Washington in the case area?

A Yes. I mean, I think obviously in this case it starts with the habitat. I mean, that's really where a lot of the -- that's where the fish production comes from, and that's where a lot of effort is going to try to protect and restore those habitats, so I think that's the most important one.

Q Is there a difference between protecting habitat and

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restoring the habitat? Could you explain what that is?

A Sure. Well, protection -- first I should step back and say that often when we use the term “restoration,” it’s used in a very general sense to include things that include mitigation, habitat protection, as well as improvement of habitat.

Specifically protection, we usually -- while we lump that in with restoration activities, it usually involves either buying up habitat to protect it or getting conservation easements to protect it or in taking regulatory action or changing existing laws to further protect habitat.

Q I’m going to show you a page from that 2002 paper.

Do you recognize this diagram?

A Yes, I do.

Q Do you know who prepared it?

A Yes. I did, along with some input from the coauthors of the paper.

Q Dr. Roni, I’m going to focus a little bit on the upper left quadrant.

Do you see that area?

A Yes.

Q Can you explain generally what this flowchart diagram shows?

A So basically this flowchart is a combination of what we know about the effectiveness of different habitat restoration

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techniques and what we know about how they restore watershed processes, and it describes an initial way of prioritizing restoration projects in the absence of very detailed limiting factors analyses. So it's a basic starting point for how to prioritize actions when you have some basic watershed assessment information.

Q Could you describe what the limiting factors analyses is?

A Sure. I think the little testimony that I've heard in this case, it seems like it's actually being misused from the standpoint of the way we tend to use it, at least the research scientists that I work with would use it.

A true limiting factors analyses is basically an analyses of the types of -- the habitat loss in the watershed, the different types of habitat, the fish production for each life stage of a particular species, to figure out exactly which life stage and which types of habitat are limiting the production of fish.

The classic paper on this is Beechie, et al, 1994, which was done for coho salmon in the Skagit River system. Often people refer to limiting -- we throw that term around, "limiting factor analyses" for things that are really just an assessment or a list of problems in the watershed.

But in my view, a true limiting factors analyses is trying to get at which -- as a detailed analysis trying to get at which life stage and which habitats are limiting that life

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stage for a particular salmon species.

Q Are true limiting factors analyses, in your judgment, available for all watersheds in the case area?

A No. To my knowledge, they've been done in Skagit for coho. I think they've done it for Chinook as well. It's been done on the Stillaguamish for coho. Most of the other watersheds, to my knowledge, have not done a limiting factors analyses.

The documents that are referred to as limiting factors analyses, I know that there was the -- I think it was Smith 2000 or 1999. Carol Smith had put together these limiting factors analyses for the different watersheds throughout the state. Those are really what we would consider just a synthesis of available information and a list of the key problems in the watershed. They're not necessarily identifying which of those habitat types or problems are limiting the production of salmon. So we have those for all the watersheds, but they're not what I would refer to as a limiting factors analyses.

Q Are limiting factors analyses specific to a particular species of salmon?

A Yes. They've been done most commonly for coho because we probably have the best information for that species, but it's species specific. So if you wanted to look at doing restoration actions for multiple species, you need to do one

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for each and then try to weigh those, because obviously the actions you might have meant for one species would differ from another.

Q Would the habitat needs for Chinook salmon be the same as for coho, for example?

A No. There would be a little bit of overlap, but they're quite different. So that's why the limiting factors analyses that have been done for the coho in the Skagit or the Stillaguamish are quite a bit different from those for, I think chinook they've done them for.

Q If you don't have a detailed true limiting factors analysis, as you've described it, you mentioned earlier that that reconnecting habitat is important.

Why is that?

A So what -- well, basically we came up with a system for prioritizing restoration actions based on if you didn't have a true limiting factors analysis, this was sort of an internal approach, this figure that you have up on the screen.

And so one of the first things that we -- that I and my coauthors would recommend that we do is that we focus on protecting high-quality habitat, and then the next thing would be reconnecting isolated habitats. So that would be pretty -- obviously this figure is a bit high.

Q Is there a pretty high probability of success through

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reconnecting habitat?

A Well, I think -- yeah. I mean, from the different restoration actions, it's one of the most successful for a couple of reasons. One is because it relies on existing habitat instead of trying to improve marginal or improve okay habitat.

Also what we see is that the fish colonize these areas very quickly, so it's one of the most successful from getting -- the response time is very quick, where some of the other techniques might take decades before we see response, or they might only last -- some of the other habitat improvement techniques might only last a few decades before we have to repeat.

Q When you say the response times is quick, what time period are you thinking of?

A Well, the studies that we've done and that others have done, I don't know that they've got it down to the day, but it's pretty clear that the fish would colonize the watersheds -- the area fairly quickly.

So there's -- we have one study that we've done on a stream down in Oregon where they removed small barriers, a dam of about 20 feet high, on a relatively small stream. And within a week of removing that dam, there were salmon that had moved up there, both juveniles and some adults. It's more akin to -- I think that one of the problems we have is

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we tend to think that it might take years for fish to colonize an area.

But I would say it's more akin to having a fenced backyard with a couple of dogs in it. And if you remove the fence, the dogs don't wait around a year to decide if they're going to go into the neighborhoods' yard. They go over there pretty quickly. So we really see fish moving into those areas pretty quickly.

Q Thank you. I'd like to have you turn your attention to Dr. Koenings' testimony, both his written testimony and his testimony in court that you heard earlier during this trial.

I believe Dr. Koenings, and I'm just going to summarize his testimony, explained that the best way to recover salmon was to do -- address all of the Hs, so to speak, concurrently and do a little bit in all the sectors at the same time and work from the bottom up.

Is that a fair characterization of his testimony, as you recall it?

A I think that's what I heard, yes.

Q Do you agree with that approach?

A Not entirely.

Q Why not?

A I think that it's pretty clear that the habitat, the rest -- also implied in his answer is that with habitat restoration, we're going to address all the different factors

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at the same time. Starting with the four Hs, I think we need to start by focusing on habitat because that's where it all started and that's what it really depends on.

The other thing that made me uncomfortable about that was that again, it sounded like he was talking about we should do this sort of bottom up or, I should say, attack all -- try to address all the habitat problems at the same time. And that's largely, I think, what has been the failure of most previous salmon restoration or habitat restoration efforts, is doing a lot of little things across the landscape and not really trying to address some of the key factors first.

Q Dr. Koenings also testified about the current efforts underway to restore salmon, and I think he mentioned the local -- the bottom-up approach, the local watershed councils and that sort of thing.

Are there -- do you have any disagreement with the notions of the bottom-up approach?

A Well, again, I think that what this has led to is lots of -- and this is partly from my experience on the recovery implementation technical team and partly my experience in working with different practitioners on evaluating restoration projects.

The bottom-up approach or the current approach we have leads to the different groups that are doing restoration actions proposing whatever they can get done, whatever they

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to get some of these areas.

Q Do you know if that approach has been criticized by other groups?

A Well, I think it's been -- I mean, it's been criticized. I mean, this is a topic of discussion in the recovery implementation technical team in Puget Sound and the other recovery implementation technical teams that NOAA has set up in different parts of the Northwest here. It also was – I mean, I think back when the state prepared their "Extinction is Not an Option" report, the independent science review panel reviewed that and basically criticized it very heavily because it relied on voluntary efforts and that those type of efforts have not been successful.

So I think there's a history of the scientific community criticizing the recovery plans for relying on voluntary efforts.

Q Turning your attention, Dr. Roni, to restoring the connectivity to isolated habitats, does it matter if the upstream habitat that has opened up is a very high quality or a moderate quality? Does that play a role in deciding whether to open up that area?

A Well, I think historically, you know, that was one of the factors that was considered most important. In our more recent research where we've evaluated barrier removals, we see that really the amount of habitat is probably – assuming

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the habitat is okay or even marginal, the amount seems to be more important than the actual quality. And the example I would give there is the Cedar River Watershed where we've been monitoring the Landsburg Diversion Dam. City of Seattle water supply has blocked fish access there for about a hundred years. And about five or six years ago, they put a fish ladder on that, and we've been monitoring the recolonization of the fish in that watershed.

And while it's in a protected area, the whole watershed was probably logged probably 50 years ago, and it's not particularly high quality habitat, it's okay, but we've seen fish colonize it fairly rapidly, both juveniles and adults. So that and a few other studies are really suggesting that if you give them the access and the habitat is even marginal or okay quality, they'll colonize it fairly quickly.

Again, I would use the dogs in the backyard example, where I think the salmon are -- they move around a lot. And so it's not like -- again, you know, if you remove the fence, your dog's not going to wonder whether the yard next door is suitable. He's going to go over there. And it seems to be the same for both juvenile and adult salmon. They move around a lot at certain times of the year and explore different habitats.

Q Dr. Koenings in his testimony talked about the interrelationship between hatchery fish and wild fish.

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fish to recolonize those areas.

So I think in many of the watersheds where we have mixed production, you know, that's what we're -- I guess I don't see the hatchery fish as a problem. We're already relying on them for some of the recolonization and recovery.

Q Some have argued that if there are other culverts, for example, on a stream that are partial barriers or even full barriers to salmon, that it would be perhaps not the best use of funds to spend money to correct an upstream state-owned culvert, for example.

Do you agree with that?

A I think the -- well, many times these culverts are partial barriers. So my concern would be that if we didn't replace a state-owned culvert because there was a downstream fish passage barrier or a partial barrier, then we would be foregoing habitat that is used sometimes already.

Also from just experience in working with some of the restoration practitioners, in particularly I worked a lot with the Bureau of Land Management down in Oregon, they – to get private landowners to agree to restoration actions or the removal of culverts on their land, they basically demonstrate -- they get the landowners to go along by taking care of their culverts and their restoration first and then work with the landowners to try and get them to get theirs as well.

So I think it would be -- that's not necessarily a

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technical issue, but it's sort of from a leverage standpoint of trying to get those restoration actions, it's sort of important for the feds and the states to demonstrate.

Q To act as role models, then, in effect?

A I would think so.

Q Okay. Dr. Koenings also discussed the effect of climate change. And I believe he discussed that in relationship to state-owned culverts, for example.

What is your view on whether the climate change should be a basis for accelerating the repair of culverts or not accelerating the repair of culverts?

A So I think that the predictions for climate change are obviously that we're going to see changes in stream flows and changes in stream temperature. And in terms of restoration actions -- and actually, myself and Dr. Beechie have been working on a paper to talk about how to address restoration under climate change, which types of actions you might do.

And obviously, the critical thing is if we're going to see changes in water temperature, we need to have -- we need to make sure that the fish have access to all these different habitats that they might use; that they have access to some of the upstream habitats where usually the water temperature is lower. So one of the best things under a climate change scenario is to make sure that we're -- all the habitats are connected and the fish have access. Because otherwise, if

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the temperature's going up, they're not going to be able to move into the cool water refuges.

Q So they need more habitat rather than less?

A Yeah. Well, more, and access to those habitats.

Q In his testimony, both his written testimony and I believe on the stand, Dr. Koenings discussed the entire four H process, and we need to address all of the Hs and so forth.

I was left at least with the implication that there's necessarily a tradeoff between, say, correcting state-owned culverts on Department of Transportation roads and correcting hatchery management actions or habitat management actions?

Do you see any kind of tradeoff in that regard?

A Between -- the tradeoff --

Q Between restoring connectivity by fixing culverts on state-owned roads and that necessarily reduce the amount of effort that would be devoted to corrections in the other Hs?

A I don't think so. I mean, it seems that the discussion is mainly over what types of habitat restoration would be funded, as the funds are -- the funds that are being used for habitat restoration are not coming from the same sources. And most of these other activities that we've been discussing are already being addressed through other processes.

Q Okay. Thank you.

Earlier in this trial, the court has asked prior witnesses what they would do if there was a new bushel of

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money that dropped out of the sky, I believe, and what would they do differently, what would they do the same with respect to habitat restoration.

Would your approach to habitat restoration activities, your suggested approach focus in on, for example, restoring connectivity, would that change if more money was available?

A Well, yes and no. I think that we would – initially because it's going to take some time to do kinds of proper assessments and limiting factors analyses in each watershed, that we would go with our interim approach that we've proposed and focus on, you know, protecting the high-quality habitats, reconnecting the isolated habitats, because that's -- again, we know the response time is quick, and it's been shown to be critical for a number of listed salmon species, if that's what we've lost, habitat. And then focus on some of these other restoration of other watershed processes, like the delivery of wood, water and sediment. And then once we had -- so that would be the initial approach.

And then as we complete the limiting factors analyses, we can refine that, change that, and focus in on things that would be most important for the particular species of interest.

Q Now, as we heard this morning in testimony from the Department of Transportation, this funding isn't inexhaustible. There are some limitations to funding. We

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all know that from our personal lives as well as the current economy.

If money is limited, would your priorities be as you suggested?

A Yeah. I think we're in the same situation, because I don't think we can -- we can't necessarily stop to spend all our money doing limiting factors analyses. So we would follow the same approach until we get some other information that suggests otherwise.

Q And so that would involve still correcting the barriers to fish passage, reconnecting habitats, for example?

A Yeah. So I think the starting points are obviously protecting habitat, and that's been borne out in the literature and conservation biology for years, that we have to protect the good stuff and stem the tide of habitat loss, and then focus on reconnecting isolated habitats. Some of that would be culverts and those types of barriers. Some of that might be removing levies or dikes to isolated areas for habitats is important for different species.

MR. MONSON: Thank you.

Your Honor, may I have a moment to consult with counsel? I believe I might be through. Your Honor, I have no further questions of this witness on direct. Thank you.

THE COURT: Cross-examination, Mr. Ferester?

MR. FERESTER: Your Honor, first I'd like to address

FRANKLIN PIERCE,

Dec. 26, 1854

PRESIDENT OF THE UNITED STATES OF AMERICA,

TO ALL AND SINGULAR TO WHOM THESE PRESENTS SHALL COME, GREETING:

Title

WHEREAS a treaty was made and concluded on the She-nah-nam, or Medicine Creek, in the Territory of Washington, on the twenty-sixth day of December, one thousand eight hundred and · fifty-four, between the United States of America and the Nisqually and other bands of Indians, which treaty is in the words following, to wit:—

Articles of agreement and convention made and concluded on the She- nah-nam, or Medicine Creek, in the Territory of Washington, this twenty-sixth-day of December, in the year one thousand eight hundred and fifty- four, by Isaac I. Stevens, governor and superin-tenddent of Indian affairs of the said Territory, on the part of the United States, and the under-signed chiefs, headmen, and delegates of the Nisqually, Puyallup, Steilacoom, Squawksin, S'Homamish, Steh-chass, T'Peeksin, Squi-aitl, and Sa-heh-wamish tribes and bands of Indians, occupying the lands lying round the head of Puget's Sound and the adjacent inlets, who, for the purpose of this treaty, are to be regarded as one nation, on behalf of said tribes and bands, and duly authorized by them.

Cession to United States.

ARTICLE I. The said tribes and bands of Indians hereby cede, relinquish, and convey to the United States, all their right, title, and interest in and to the lands and country occupied by them, bounded and described as follows, to wit: Commencing at the point on the eastern side of Admiralty Inlet, known as Point Pully, about midway between Commencement and Elliott bays ; thence running in a southeasterly direction, following the divide between the waters of the Puyallup and Dwamish, or White rivers, to the summit of the Cascade Mountains ; thence southerly, along the summit of said range, to a point opposite the main source of the Skookum Chuck Creek ; thence to and down said creek, to the coal mine ; thence northwesterly, to the summit of the Black Hills ; thence northerly, to the upper forks of the Satsop River ; thence northeasterly, through the portage known as Wilkes's Portage, to Point Southworth, on the western side of Admiralty Inlet ; thence around the foot of Vashon's Island, easterly and southeasterly, to the place of beginning.

Reservation for

ARTICLE II. There is, however, reserved for the present use and occupation of the said tribes and bands, the following tracts of land, viz : The small said tribes.

island called Klah-che-min, situated opposite the mouths of Hammersley's and Totten's inlets, and separated from Hartstene Island by Peale's Passage, containing about two sections of land by estimation; a square tract containing two sections, or twelve hundred and eighty acres, on Puget's Sound, near the mouth of the She-nah-nam Creek, one mile west of the meridian line of the United States land survey, and a square tract containing two sections, or twelve hundred and eighty acres, lying on the south side of Commencement Bay; all which tracts shall be set apart, and, so far as necessary, surveyed and marked out for their exclusive use ; nor shall any white man be permitted to reside upon the same without permission of the tribe and the superintendent or agent. And the said tribes and bands agree to remove to and settle upon the same within one year after the ratification of this treaty, or sooner if the means are furnished them. In the mean time, it shall be lawful for them to reside upon any ground not in the actual claim and occupation of citizens of the United States, and upon any ground claimed or occupied, if with the permission of the owner or claimant. If necessary for the public convenience, roads may be run through their reserves, and, on the other hand, the right of way with free access

Removal thereto.

Roads may be constructed.

from the same to the nearest public highway is secured to them.

Right to fish.

ARTICLE III. The right of taking fish, at all usual and accustomed grounds and stations, is further secured to said Indians, in common with all citizens of the Territory, and of erecting temporary houses for the purpose of curing, together with the privilege of hunting, gathering roots and berries, and pasturing their horses on open and unclaimed lands: *Provided, however*, That they shall not take shell fish from any beds staked or cultivated by citizens, and that they shall alter all stallions not intended for breeding horses, and shall keep up and confine the latter.

Payments for said cession.

ARTICLE IV. In consideration of the above cession, the United States agree to pay to the said tribes and bands the sum of thirty-two thousand five hundred dollars, in the following manner, that is to say: For first year after the ratification hereof, three thousand two hundred and fifty dollars ; for the next two years, three thousand dollars each year ; for the next three years two thousand dollars each year ; for the next four years fifteen hundred dollars each year ; for the next five years twelve hundred dollars each year, and for the next five years one thousand dollars each year ; all which said sums of money shall be applied to the use and benefit of the said Indians, under the

How applied.

direction of the President of the United States, who may from time to time determine, at his discretion, upon what beneficial objects to expend the same. And the superintendent of Indian affairs, or other proper officer, shall each year inform the President of the wishes of said Indians in respect thereto.

Expense of removal, &c.

ARTICLE V. To enable the said Indians to remove to and settle upon their aforesaid reservations, and to clear, fence, and break up a sufficient quantity of land for cultivation, the United States further agree to pay the sum of three thousand two hundred and fifty dollars, to be laid out and expended under the direction of the President, and in such manner as he shall approve.

Removal from said reserve-tion.

ARTICLE VI. The President may hereafter, when in his opinion the interests of the Territory may require, and the welfare of the said Indians be promoted, remove them from either or all of said reservations to such other suitable place or places within said Territory as he may deem fit, on remunerating them for their improvements and the expenses of their removal, or may consolidate them with other friendly tribes or bands. And he may further, at his discretion, cause the whole or any portion of the lands hereby reserved, or of such other land as may be selected in lieu thereof, to be surveyed into lots, and assign the same to such individuals or families as are willing to avail themselves of the privilege, and will locate on the same as a permanent home, on the same terms and subject to the same regulations as are provided in the sixth article of the treaty with the Omahas, so far as the same may be applicable. Any substantial improvements heretofore made by any Indian, and which he shall be compelled to abandon in consequence of this treaty, shall be valued under the direction of the President, and payment be made accordingly therefor.

Annuities not to be taken for debts.

ARTICLE VII. The annuities of the aforesaid tribes and bands shall not be taken to pay the debts of individuals.

Stipulations respecting conduct of Indians.

ARTICLE VIII. The aforesaid tribes and bands acknowledge their dependence on the government of the United States, and promise to be friendly with all citizens thereof, and pledge themselves to commit no depredations on the property of such citizens. And should any one or more of them violate this pledge, and the fact be satisfactorily proved before the agent, the property taken shall be returned, or in default thereof, or if injured or destroyed, compensation may be made by the government out of their annuities. Nor will they make war on any other tribe except in self-defence, but will submit all matters of difference between them and other Indians to the government of the United States, or its agent, for decision, and abide thereby. And if any of the said Indians commit any depredations on any other Indians within the Territory, the same rule shall prevail as that prescribed in this article, in cases of depredations against citizens. And the said tribes agree not to shelter or conceal offenders against the laws of the United States, but to deliver them up to the authorities for trial.

Intemperance.

ARTICLE IX: The above tribes and bands are desirous to exclude from their reservations the use of ardent spirits, and to prevent their people from drinking the same ; and, therefore, it is provided, that any Indian belonging to said tribes, who is guilty of bringing liquor into said reservations, or who drinks liquor, may have his or her · proportion of the annuities withheld from him or her for such time as the President may determine.

Schools, shops, &c.

ARTICLE X. The United States further agree to establish at the general agency for the district of Puget's Sound, within one year from the ratification hereof, and to support, for a period of twenty years, an agricultural and industrial school, to be free to children of the said tribes and bands, in common with those of the other tribes of said district, and to provide the said school with a suitable instructor or instructors, and also to provide a smithy and carpenter's shop, and furnish them with the necessary tools, and employ a blacksmith, carpenter, and farmer, for the term of twenty years, to instruct the Indians in their respective occupations. And the United States further agree to employ a physician to reside at the said central agency, who shall furnish medicine and advice to their sick, and shall vaccinate them ; the expenses of the said school, shops, employees, and medical attendance, to be defrayed by the United States, and not deducted from the annuities.

Slaves to be freed.

ARTICLE XI. The said tribes and bands agree to free all slaves now held by them, and not to purchase or acquire others hereafter.

Trade out of the limits of the U.S. forbidden.

Foreign Indians not to reside on reserve-tion.

ARTICLE XII. The said tribes and bands finally agree not to trade at Vancouver's Island, or elsewhere out of the dominions of the United States; nor shall foreign Indians be permitted to reside in their reservations without consent of the superintendent or agent.

Treaty, when to take effect.

ARTICLE XIII. This treaty shall be obligatory on the contracting parties as soon as the same shall be ratified by the President and Senate of the United States.

In testimony whereof, the said Isaac I. Stevens, governor and superintendent of Indian Affairs, and the undersigned chiefs, headmen, and delegates of the aforesaid tribes and bands, have hereunto set their hands and seals at the place and on the day and year hereinbefore written.

ISAAC I. STEVENS, [L. S.]

Governor and Superintendent Territory of Washington.

QUI-EE-METL,	his x mark.	[L. S.]
SNO-HO-DUMSET,	his x mark.	[L. S.]
LESH-HIGH,	his x mark.	[L. S.]
SLIP-O-ELM,	his x mark.	[L. S.]
KWI-ATS,	his x mark.	[L. S.]
STEE-HIGH,	his x mark.	[L. S.]
DI-A-KEH,	his x mark.	[L. S.]
HI-TEN,	his x mark.	[L. S.]
SQUA-TA-HUN,	his x mark.	[L. S.]
KAHK-TSE-MIN,	his x mark.	[L. S.]
SONAN-O-YUTL,	his x mark.	[L. S.]
KL-TEHP,	his x mark.	[L. S.]
SAHL-KO-MIN,	his x mark.	[L. S.]
T'BET-STE-HEH-BIT,	his x mark.	[L. S.]
TCHA-HOOS-TAN,	his x mark.	[L. S.]
KE-CHA-HAT,	his x mark.	[L. S.]
SPEE-PEH,	his x mark.	[L. S.]

SWE-YAH-TUM,	his x mark. [L. S.]
CHAH-ACHSH,	his x mark. [L. S.]
PICH-KEHD,	his x mark. [L. S.]
S'KLAH-O-SUM,	his x mark. [L. S.]
SAH-LE-TATL,	his x mark. [L. S.]
SEE-LUP,	his x mark. [L. S.]
E-LA-KAH-KA,	his x mark. [L. S.]
SLUG-YEH,	his x mark. [L. S.]
HI-NUK,	his x mark. [L. S.]
MA-MO-NISH,	his x mark. [L. S.]
CHEELS,	his x mark. [L. S.]
KNUTCANU,	his x mark. [L. S.]
BATS-TA-KOBE,	his x mark. [L. S.]
WIN-NE-YA,	his x mark. [L. S.]
KLO-OUT,	his x mark. [L. S.]
SE-UCH-KA-NAM,	his x mark. [L. S.]
SKE-MAH-HAN,	his x mark. [L. S.]
WUTS-UN-A-PUM,	his x mark. [L. S.]
QUUTS-A-TADM,	his x mark. [L. S.]
QUUT-A-HEH-MTSN,	his x mark. [L. S.]
YAH-LEH-CHN,	his x mark. [L. S.]
TO-LAHL-KUT,	his x mark. [L. S.]
YUL-LOUT,	his x mark. [L. S.]
SEE-AHTS-OOT-SOOT,	his x mark. [L. S.]

YE-TAHKO,	his x mark. [L. S.]
WE-PO-IT-EE,	his x mark. [L. S.]
KAH-SLD,	his x mark. [L. S.]
LA'H-HOM-KAN,	his x mark. [L. S.]
PAH-HOW-AT-ISH,	his x mark. [L. S.]
SWE-YEHM,	his x mark. [L. S.]
SAH-HWILL,	his x mark. [L. S.]
SE-KWAHT,	his x mark. [L. S.]
KAH-HUM-KLT,	his x mark. [L. S.]
YAH-KWO-BAH,	his x mark. [L. S.]
WUT-SAH-LE-WUN,	his x mark. [L. S.]
SAH-BA-HAT,	his x mark. [L. S.]
TEL-E-KISH,	his x mark. [L. S.]
SWE-KEH-NAM,	his x mark. [L. S.]
SIT-OO-AH,	his x mark. [L. S.]
KO-QUEL-A-CUT,	his x mark. [L. S.]
JACK,	his x mark. [L. S.]
KEH-KISE-BE-LO,	his x mark. [L. S.]
GO-YEH-HN,	his x mark. [L. S.]
SAH-PUTSH,	his x mark. [L. S.]
WILLIAM,	his x mark. [L. S.]

Executed in the presence of us : —

M. T. Simmons,
Indian Agent.

JAMES DOTY
Secretary of the Commission.

C. H. MASON,
Secretary Washington Territory.

W. A. SLAUGHTER,
1st Lieut. 4th Infantry.

JAMES MCALISTER,

E. GIDDINGS, jr.,

GEORGE SHAZER,

HENRY D. COCK,

S. S. FORD, jr.,

JOHN W. McALISTER,

CLOVINGTON CUSHMAN,

PETER ANDERSON,

SAMUEL KLADY,

W. H. PULLEN,

P. O. HOUGH,

E. R. TYERALL,

GEORGE GIBBS,

BENJ. F. SHAW, *Interpreter*,

HAZARD STEVENS.

And whereas the said treaty having been submitted to the Senate of the United States, for its constitutional action thereon, the Senate did, on the third day of March, one thousand eight hundred and fifty-five, advise and consent to the ratification of its articles by a resolution in the words and figures following, to wit : —

"IN EXECUTIVE SESSION, SENATE OF THE UNITED STATES,

"March 3, 1855.

"*Resolved*, (two thirds of the senators present concurring,) That the Senate advise and consent to the ratification of the articles of agreement and convention made and concluded on the She-nah-nam, or Medicine Creek, in the Territory of Washington, this twenty-sixth day of December, in the year one thousand eight hundred and fifty-four, by Isaac I. Stevens, governor and superintendent of Indian affairs of the said Territory, on the part of the United States, and the undersigned chiefs, headmen, and delegates of the Nisqually, Puyallup, Steilacoom, Squawksin, S'Hom-amish, Steth-chass, T'Peeksin, Squi-aitl, and Sa-heh-wamish tribes and bands of Indians occupying the lands lying round the head of Puget's Sound and the adjacent inlets, who, for the purpose of this treaty, are to be regarded as one nation, on behalf of said tribes and bands, and duly authorized by them.

"Attest : ASBURY DICKINS,

"Secretary."

Now, therefore, be it known that I, FRANKLIN PIERCE, President of the United States of America, do, in pursuance of the advice and consent of the Senate, as expressed in their resolution of the third day of March, one thousand eight hundred and fifty-five, accept, ratify, and confirm the said treaty.

In testimony whereof, I have caused the seal of the United States to be hereto affixed, having signed the same with my hand.

[L. S.] Done at the city of Washington, this tenth day of April, in the year of our Lord one thousand eight hundred and fifty-five, and of the independence of the United States the seventy-ninth.

FRANKLIN PIERCE

by the President :
W. L. MARCY, *Secretary of State*.

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Alan C. Stay
Attorney at Law
SMALL TRIBES ORGANIZATION
OF WESTERN WASHINGTON
P. O. Box 578
Sumner, WA 98390
(206) 593-2776
Attorney for:
Muckleshoot, Squaxin Island,
Stillaguamish, Sauk-Suiattle,
Nooksack, Steilacoom, Samish,
Snohomish, and Suquamish
Indian Tribes

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT TACOMA

UNITED STATES OF AMERICA Plaintiff and QUILEUTE, MAKAH, LUMMI, MUCKLESHOOT, SQUAXIN ISLAND, SKOKOMISH, LOWER ELWHA, SNOQUALMIE, DUWAMISH, YAKIMA, STILLAGUAMISH, SAUK-SUIATTLE, HOH, NISQUALLY, SWINOMISH, TULALIP, PUYALLUP, QUINAULT, UPPER SKAGIT, NOOKSACK, STEILACOOM, SUQUAMISH, SAMISH, SNOHOMISH, SWINOMISH, PORT GAMBLE AND SNOQUALMIE INDIAN TRIBES Plaintiff-Intervenors vs. STATE OF WASHINGTON Defendant and STATE OF WASHINGTON DEPARTMENT OF FISHERIES and STATE OF WASHINGTON DEPARTMENT OF GAME Defendant-Intervenors.	CIVIL NO. 9 2 1 3 AMENDED AND SUPPLEMENTAL COMPLAINT FOR DECLARATORY JUDGMENT RECEIVED SEP 29 1976 DEPARTMENT OF GAME ATTORNEY GENERAL'S OFFICE

JURISDICTION

This amended complaint is supplemental to the complaints filed by Plaintiff United States and Plaintiff Indian Tribes at

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The economic development of the State, the growth of the State's non-Indian population and the agricultural and industrial advances of recent times, have resulted in a fishery vastly different from the fishery existing at the time of the treaties which was primarily an Indian fishery. The size and nature of fish populations have been substantially altered by numerous activities impairing or destroying the acquatic habitats necessary to maintain them. Whole watersheds have been rearranged or destroyed to make room for development; fresh and saltwater systems have been polluted and subjected to changes in flow, level velocity and temperature; migration routes have been restricted or blocked; spawning beds have been damaged or destroyed; artificially introduced fish populations have displaced native populations; predator and disease problems have been aggravated; and generally the ecological balance necessary to maintain the Indian fishery has been seriously tampered with. This destruction or alteration of fish habitats could have been controlled or prevented in part by the Defendant State and its agencies, but was not. Much of it actually occurred pursuant to explicit administrative authorization contained in State-issued permits and approvals.

During this same period of growth, a large non-Indian commercial fishery came into being, providing employment and economic opportunities for a substantial portion of the citizenry. The increasing demands of this commerical fishery have threatened the survival of the resource. An expanding sport fishery has further increased this pressure. The Defendant State, at all times prior to this Court's Final Decision No. 1, has had the power to prevent the substantial diminution of the fishery resource by limiting sporting and commerical licensing, but has elected not to do so.

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STAN PITKIN
United States Attorney
JAMES C. WALDO
Assistant United States Attorney
P. O. Box 1227
Seattle, Washington 98111
(206) 442-7970

Attorneys for Plaintiff
United States of America

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON

UNITED STATES OF AMERICA Plaintiff and QUILEUTE, MAKAH, LUMMI, MUCKLESHOOT, SQUAXIN ISLAND, SKOKOMISH, LOWER ELWHA, SNOQUALMIE, DUWAMISH, STILLAGUAMISH, SAUK-SUIATTLE, NISQUALLY, SWINOMISH, TULALIP, PUYALLUP, QUINAULT, UPPER SKAGIT, YAKIMA, NOOKSACK, STEILACOOM, SAMISH, SNOHOMISH, and PORT GAMBLE CLALLAM INDIAN TRIBES Plaintiff-Intervenors, vs. STATE OF WASHINGTON Defendant and STATE OF WASHINGTON DEPARTMENT OF FISHERIES and STATE OF WASHINGTON DEPARTMENT OF GAME Defendant-Intervenors.	CIVIL NO. 9213 AMENDED AND SUPPLEMENTAL COMPLAINT FOR DECLARATORY JUDGMENT

JURISDICTION

This amended complaint is supplemental to the complaints filed by Plaintiff United States and Plaintiff Indian Tribes at the commencement of this lawsuit or in intervention, and is filed at the specific request of this Court made in June of 1976. Trial of

[Original Page 4]

State's non-Indian population and the agricultural and industrial advances of recent times, have resulted in a fishery vastly different from the fishery existing at the time of the treaties which was primarily an Indian fishery. The size and nature of fish populations have been substantially altered by numerous activities impairing or destroying the acquatic habitats necessary to maintain them. Whole watersheds have been rearranged or destroyed to make room for development; fresh and saltwater systems have been polluted and subjected to changes in flow, level, velocity and temperature; migration routes have been restricted or blocked; spawning beds have been damaged or destroyed; artificially introduced fish populations have displaced native populations; predator and disease problems have been aggravated; and generally the ecological balance necessary to maintain the Indian fishery has been seriously tampered with. This destruction or alteration of fish habitats could have been controlled or prevented in part by the Defendant State and its agencies, but was not. Much of it actually occurred pursuant to explicit administrative authorization contained in State-issued permits and approvals.

During this same period of growth, a large non-Indian commercial fishery came into being, providing employment and economic opportunities for a substantial portion of the citizenry. The increasing demands of this commercial fishery have threatened the survival of the resource. An expanding sport fishery has further increased this pressure. The Defendant State, at all times prior to this Court's Final Decision No. 1, has had the power to prevent the substantial diminution of the fishery resource by limiting sporting and commercial licensing, but has elected not to do so.

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UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON

UNITED STATES OF AMERICA, et al., Plaintiffs, v. STATE OF WASHINGTON, et al., Defendants.	NO. 9213-II PLAINTIFF'S SUPPLEMENTAL MEMORANDUM IN SUPPORT OF MOTION FOR PARTIAL SUMMARY JUDGMENT

Plaintiff, United States of America, hereby submits its Supplemental Memorandum in Support of Motion For Partial Summary Judgment.

I

INTRODUCTION

In our initial memorandum we contend that the Federal treaty fishing right involved in this litigation reserves to treaty tribes a right to have the fishery resource protected from adverse environmental actions or inactions of the State of Washington. In support of that contention we set forth and substantiated several arguments: that the treaty fishing right recognized in Final Decision No. 1 presupposes a measure of environmental protection for the salmon/steelhead resource; that the treaties must be construed to effect the purposes for which they were signed; that

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described in general (see e.g., 01 - Nooksack - 01 to 05). The major streams within the WRIA are then described and illustrated with photographs and maps. Both the general description of the WRIA and the specific stream descriptions contain a section entitled "Limiting Factors." According to the Catalog:

> Limiting factors refer to conditions that lead to a complete loss or reduction of the environment's fish producing potential, excluding harvest or exploitation. They include only those conditions presently considered alterable.

The tribal watershed reports are also geographical. They do not track the Stream Catalog exactly because the location of the tribes did not correspond with the WRIA delineations. The watershed reports do, however, include WRIA numbers and stream numbers which correspond to the Stream Catalog system. Thus, by reviewing the Stream Catalog and the watershed reports, one is able to get a geographical perception of the extent to which man's activities are impacting the waterways of the case area.

Because of the geographical approach of the Stream Catalog and the watershed reports, the discussion which follows will focus instead on the different types of habit-affecting activity and the extent to which those activities are currently impacting the case area. The activities which we will explore include: logging, culvert placement, dams and other obstructions, channelization, gravel removal, livestock, agriculture, water withdrawal, urbanization, estuarine development, water pollution, and removal of streamside cover. The division of habitat-impacting activity into categories is, of course, somewhat arbitrary. When a logging company fails to provide an adequate streamside buffer zone, and, as a result, a salmon stream receives excessive silt, the resultant impact can be labeled "water pollution" as well as

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"logging." Likewise, the destruction of a stream bank by grazing cattle can as easily be described as "removal of streamside cover" as "livestock." We have tried, however, to create categories which would separate and reflect the most significant types of activity taking place. In other words, logging could be included in removal of streamside cover and water pollution, but we felt that as an activity, it is significant enough to merit its own section. Thus, while there is undoubted overlap, we have attempted to define the activities in such a way so as to make them mutually exclusive.

1. Dams and Other Obstructions.

This category includes any[38/] man-made structure which constitutes a total or partial barrier to migrating salmon or steelhead. It also includes a dam which, while not impeding migration, causes other adverse impacts upon the resource, such as low flows, flow fluctuations, nitrogen supersaturation, etc.

Without question, dams and other man-made obstructions have had greater impact on salmon and steelhead runs than any other single type of environmental activity. The JBS states that "[t]he most dramatic change, often causing a complete loss of the salmon and steelhead environment on stream systems in Washington State, is the series of dams which has been completed in the last 40 years." PE-3, p. 23. See, complete discussion, Id. at 23-25. The Stream Catalog noted:

> The construction of dams on major rivers and streams for hydropower and storage or for creation of a lake or reservoir for land real estate

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38/ The figures which we use and the examples which we cite are meant to exclude Federal, federally-licensed and tribal activities.

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The tribal watershed reports identified 499 incidents of habitat damage due to channelization. PE-37 through PE-51. According to those reports, the impact of channelization is being especially felt on the Nooksack River, Squalicum Creek, and Whatcom Creek (PE-37); the Skagit River (PE-38); Montague Creek and French Creek (PE-39); Thornton Creek, McAleer Creek, Lyon Creek, Issaquah Creek, Juanita Creek, and especially the Cedar River (PE-40); the Puyallup River (eighteen miles channelized -- PE-42); the Skokomish River (PE-45); and the Hoh River (PE-49).

4. Culverts.

We use the term "culvert" to refer to any pipe, conduit, tunneled drain, arched passageway, or other waterway constructed to convey water across or beneath a street, highway, railway, parking lot, or similar area.

Since culverts convey water and thus become a part of the case area waterways, improper culvert placement, size, or gradient will prevent the upstream migration of salmon and steelhead.

Culverts are rarely identified as limiting factors in the Stream Catalog. See e.g., PE-2, 19 - Lyre Hoko - 601; 20 - Soleduck Hoh - 05, 401, 1101, 1701.

The improper placement of culverts is, however, a chronic problem in streams supporting migratory fish. The watershed reports list 136 improperly placed culverts which currently exist in the case area. PE-37 through PE-51.

5. Gravel Removal.

According to the Department of Fisheries Stream Catalog:

> Removal of riverbed materials, particularly gravel, results in reduced spawning areas and causes continuous and excessive bed load