Youngs Creek Hydroelectric Project (FERC No. P-10359)

Resident Trout Monitoring Plan Annual Report

2010 Survey and Results of Pre-Project Monitoring

Prepared by:

SNOHOMISH COUNTY PUD PUBLIC UTILITY DISTRICT NO. 1

September 2010

Overview

The Public Utility District No. 1 of Snohomish County (PUD) has completed the final year of pre-Project baseline resident trout monitoring for the Youngs Creek Hydroelectric Project (FERC No. P-10359) (Project)[1]. This brief report summarizes the effort and the associated statistical inference tests [Tests 1-5] outlined in the Resident Trout Monitoring Plan (Plan) (Beak Consultants Inc. 1993)[2]. The PUD will continue to monitor the trout population after Project start up and submit annual monitoring reports to the Washington Department of Fish and Wildlife and US Fish and Wildlife Service for review as required by the Plan. Consultation documentation on this report is included in Appendix A.

As a summary, the Monitoring Plan is designed to:

(1) Assess changes in resident trout population using annual counts of the number of fish in 10 pools as an ***Index*** of trout abundance;
(2) Ensure Project-related changes in streamflow do not prevent the trout population from rebounding following a decline; and
(3) Use Least-Squared Regression 'Trend Analysis' to assess changes in trout abundance over time.

Monitoring the trout population will assess change in the population index, regardless of the cause of the changes. The surveys will monitor two types of population changes:

(1) Statistically significant trends (3 or more years of surveys); and
(2) Sudden catastrophic declines.

2010 Data

The 2010 fish abundance information (see Tables 1 and 2, Figures 1 and 2) indicated this year's number of observed fish was slightly greater than normal, averaging 10.5 fish per pool over a series of 10 pools. This number is approximately 15 percent more than the baseline average of 9.1 fish per pool. However, the 2010 observed abundance lies within one standard deviation [9.1 ± 1.6 fish/pool] of the annual survey mean over the baseline period.

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[1] Based on current construction schedule for Project to start-up in Spring 2011. If the Project is delayed to Fall 2011, an additional pre-Project survey will be conducted in August 2011.

[2] The Trout Monitoring Plan was approved by the FERC in its Order Approving Resident Trout Monitoring Plan issued June 8, 1995 [19950614-0065].

Table 1: 2010 Survey Data

Surveyors: Ron Campbell and Mike Gagner/Keith Binkley and Larry Lowe **Date:** 8/12/10 **Time:** 0945 - 1330 hrs

Water Temp. Start: 14.0C **Finish:** 15.0C **Underwater Visibility:** 20 ft

Pool Unit #	Length (ft)	Width (ft)	Area (m2)	Max Depth (ft)	Max. Control Depth	Residual Depth (ft)	Control Feature	Species	Number of Trout by Size Class (mm)									Total Trout > 60 mm	Trout Density (f/m2)
									0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240	>240		
1	39.0	18.5	67.0	1.6	0.30	1.30	Boulder	RBT										0	0.000
2	45.0	18.0	75.2	2.6	0.40	2.20	Boulder	RBT										0	0.000
3a	34.0	16.0	50.5	2.6	0.20	2.40	Boulder	RBT				9	6	8				23	0.455
								BRK					1	1				2	0.040
4	27.0	13.0	32.6	2.6	0.30	2.30	Boulder	RBT				2	2					4	0.123
5	54.0	16.0	80.3	2.6	0.30	2.30	Bedrock	RBT		2		1	1					2	0.025
6	31.0	15.0	43.2	3.0	0.30	2.70	Boulder	RBT					3	1				4	0.093
7	38.0	19.0	67.1	4.5	0.20	4.30	Bedrock	RBT				1	1	1	1			4	0.060
8	68.0	17.0	107.4	3.8	0.35	3.45	Bedrock	RBT				4	2	2	1			9	0.084
9	27.0	10.0	25.1	4.0	0.40	3.60	Boulder	RBT				6	5	1	1			13	0.518
10	120.0	14.0	156.1	3.5	0.30	3.20	Cobble	RBT		5	1	19	18	3	2	1		44	0.282
Subtotal								RBT		7	1	42	38	16	5	1		103	
								BRK					1	1				2	
Total	48.3	15.7	70.4	3.1	0.3	2.8	Boulder		0	7	1	42	39	17	5	1	0	105	0.153

Species Code: RBT = Rainbow trout; BRK = Brook trout

Table 2: Alternate Pool Data 2008, 2009 and 2010

Surveyors:___Ron Campbell and Mike Gagner________________________ **Date:** **Time:**

Water Temp. Start: **Finish:** **Underwater Visibility:**

Pool Unit #	Length (ft)	Width (ft)	Area (m2)	Max Depth (ft)	Max. Control Depth	Residual Depth (ft)	Control Feature	Number of Rainbow Trout by Size Class (mm)									Total Trout	Trout Density (f/m2)
								0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240	>240		
Alternate Pool																		
7a-2008	52	22	106.3	3.0	0.6	2.40	Boulder				4	3	1	1			9	0.085
7a-2009	58	18	97.0	3.2	0.5	2.70	Boulder		11		6	2	3	2			13	0.134
7a-2010	55	16	81.7	3.0	0.4	2.60	LWD/Boulder					2		1			3	0.037

The 2010 fish abundance results are somewhat skewed to the high side as a result of two pools with extraordinary large numbers of observed fish. Pools #3 and #10 had more than 25 fish per pool, each. Like last year, the two lowermost pools remained devoid of fish likely as a result of seasonal flow cessation in the alluvial portion of the study reach. Although no live fish were present, it was interesting to note Pool #2 had six dead trout in the deepest portion of the pool. Based on the condition of the fish, surveyors estimated the mortalities likely occurred within the last two or three days.

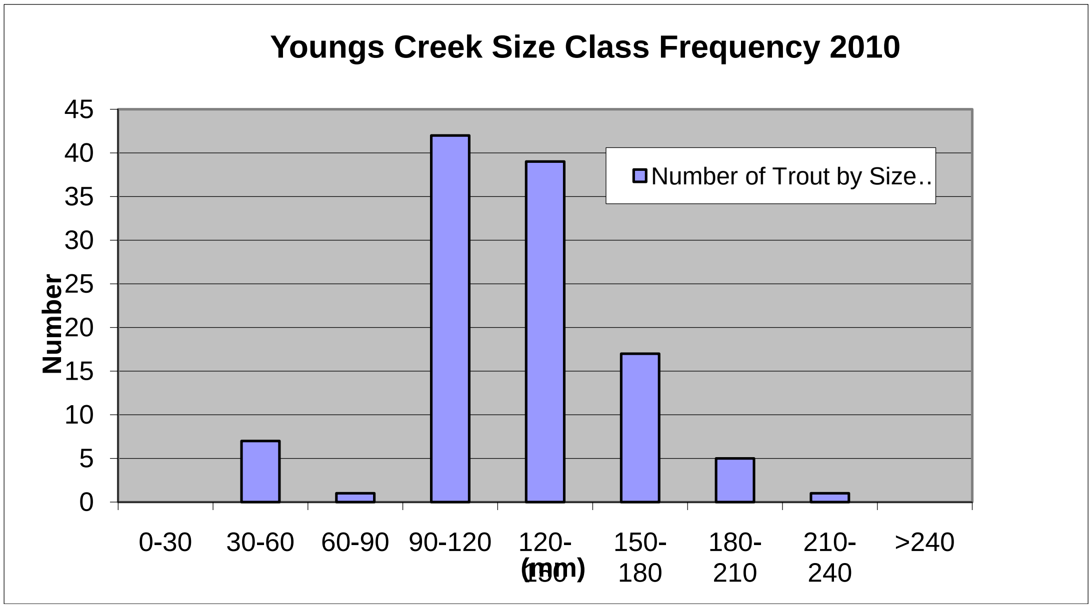

Figure 1: Number of Trout by Size Class (mm)

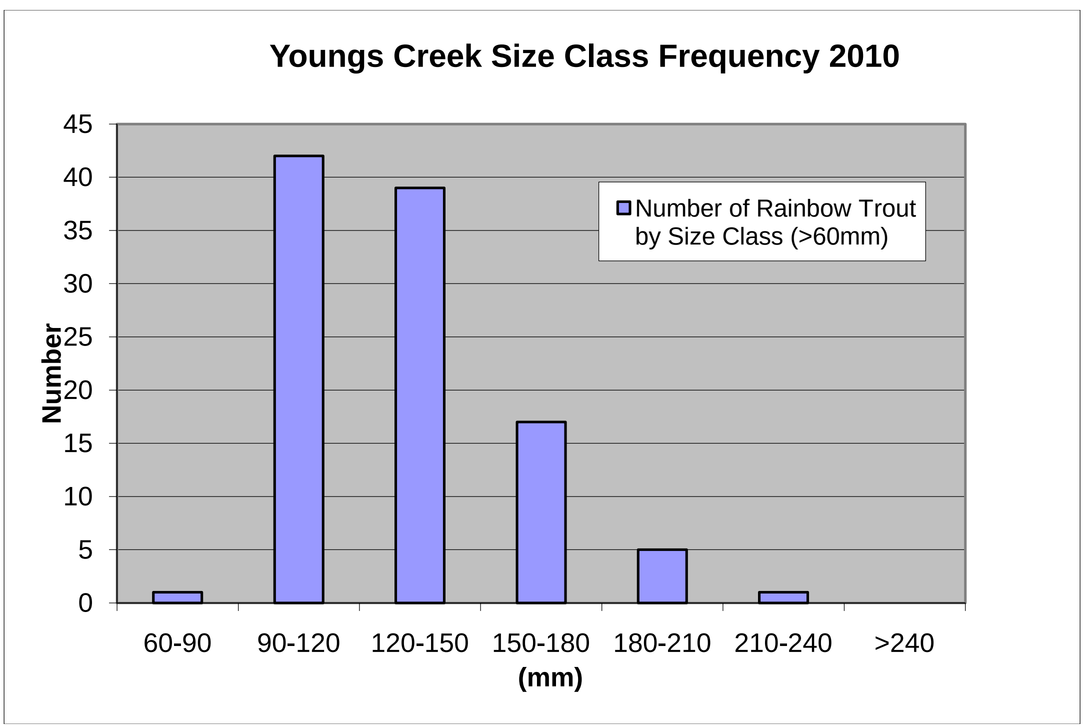

Figure 2: Number of Rainbow Trout by Size Class (>60mm)

One observation this year is the first noted presence of brook trout (see Figure 3) in the monitoring reach. Two dead and two live brook trout (120 – 160mm) were observed in Pools #2 and #3, respectively, downstream of the inter-gorge slide. Brook trout represented less than 2 percent of the species abundance for the entire monitoring reach.

Figure 3: Underwater picture of brook trout in Pool #3.

Surveyors noted very few young-of-the-year trout (subyearling fry less than 60 mm in length) during this year's survey as shown in the size class frequency chart (Figure 1). This observation suggests juvenile recruitment to the study area next year may be low. However, the current abundance of yearling fish should bode well for the adult population.

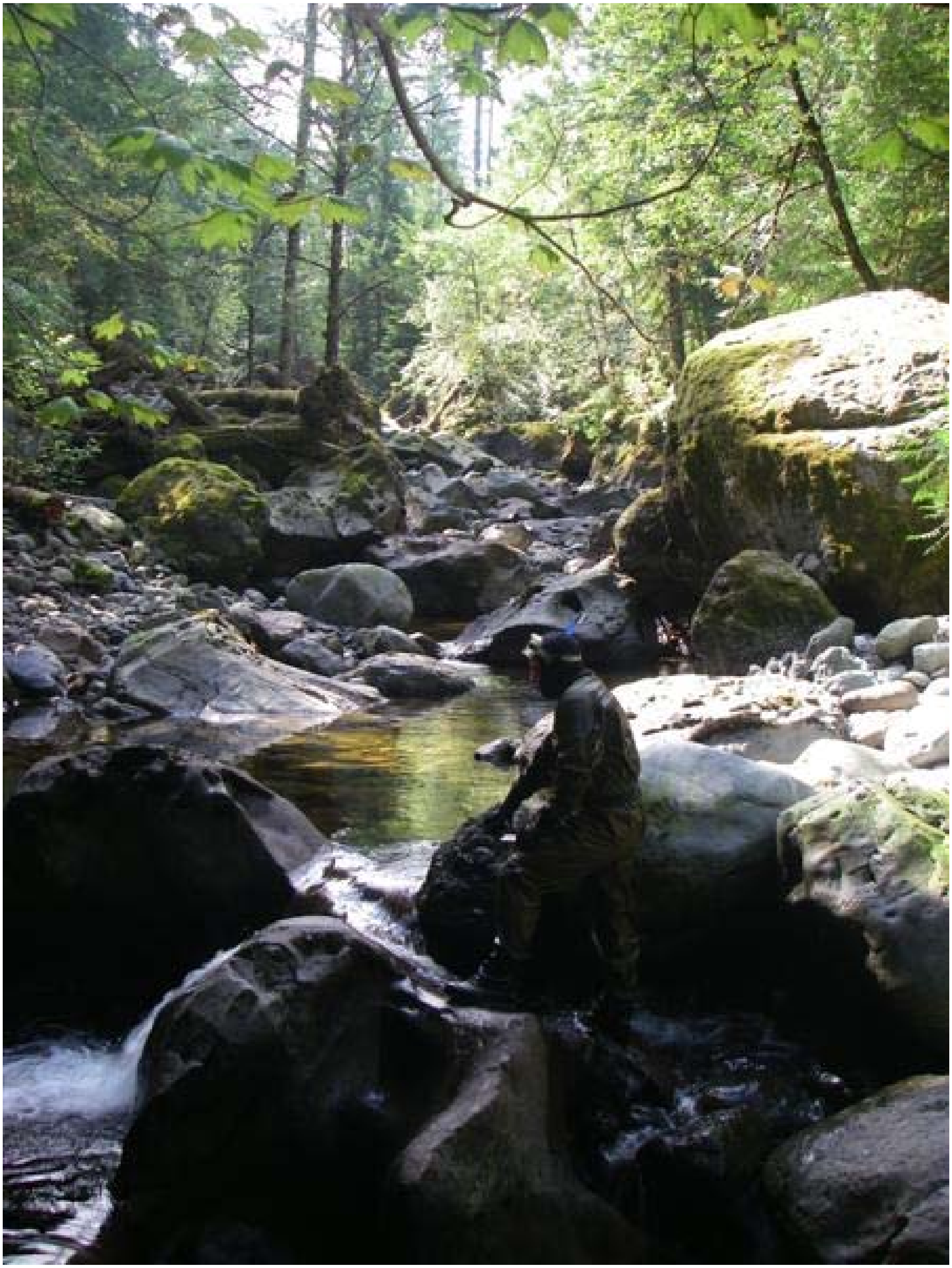

Figure 4: Longitudinal view of the creek include Pool #5, looking upstream.

Figure 5: Longitudinal view at Pool #8, looking downstream.

Also to note, on August 19, 2010, portions of Youngs Creek dried up completely (see Figures 6-17 depicting the creek bed in pools 1 through 4). Since this dry event occurred after the 2010 survey fieldwork, the results in the tables and figures of this report represent the collected survey data.


Figure 6: Monitoring Site – Dry


Figure 7: Monitoring Site – Dry


Figure 8: Monitoring Site – Dry


Figure 9: Monitoring Site – Dry


Figure 10: Monitoring Site – Dry


Figure 11: Monitoring Site – Dry

Figure 12: Monitoring Site – Dry

Figure 13: Monitoring Site – Dry

Figure 14: Monitoring Site – Dry


Figure 15: Monitoring Site – Dry


Figure 16: Monitoring Site – Dry

Figure 17: Monitoring Site – Dry

Pre-Project Baseline

A catastrophic decline during the first year of operation has been defined for the Youngs Creek Monitoring Plan as a 75 percent decline in the mean pre-Project population index from all surveys [Test 1]. ‘*Mean pre-project population index from all surveys*’ includes all seven monitoring surveys conducted between 1991 and 2010 using an annual assessment of 10 pools (see attached worksheet 1). By means of an example, the pre-Project data collected to date [in round numbers] ranged between 6 and 11 fish per pool and currently averages 9.1 fish per pool. Thus, one would need to record a population index following the first year of operation of less than 2.3 fish per pool to be categorized as a catastrophic event. For reference, natural population index declines reported in 1994 (6 fish per pool) and 2009 (8 fish per pool), were 32% and 11%, respectively of the mean pre-project population index. Neither decline, had they occurred post-Project operation, would have been regarded as a catastrophic event under the Monitoring Plan.

Catastrophic declines of 75 percent or more in subsequent years of operation [Years 2-5] are compared to mean population data from the period of operation rather than the pre-Project baseline period [Test 2].

Adjustments in the minimum in-stream flow regime, in accordance with the current Memorandum of Understanding among PUD, Washington Department of Fish and Wildlife and Washington Department of Ecology dated June 12, 2009, will only be implemented if:

(1) the trout population index fails to rebound to pre-project levels following a catastrophic decline in Year 1 of operation,
(2) there are two successive catastrophic population declines during 5 post-operational years, or
(3) the population index undergoes a steady, statistically significant decline over a period of 5 post-operational years.

Monitoring could end following 3 years of post-operational surveys if the minimum in-stream flow releases are considered adequate to protect the fishery resource by means of the following Test 3:

- the trout population index does not exhibit a statistically significant decline in 3 years of Project operation.

Monitoring could continue past 5 years of post-operational surveys as a factor of either: (a) determining if a near-term catastrophic decline has an opportunity to rebound [Test 5]; or (b) a longer-term statistically significant decline occurs [Test 4] resulting in resetting the minimum in-stream flow regime.

Table 3: Statistical Trend Analysis

Youngs Creek Resident Trout Monitoring Plan Statistical Trend Analysis

	Early 1990s Baseline				Late 2000s Baseline			Slope[1/]	Project Operations							
Pool #	1991	1992	1993	1994	2008	2009	2010	(m)	2011	2012	2013	2014	2015	3-yr Slope[1/]	4-yr Slope[1/]	5-yr Slope[1/]
1	3	4	7	1	3	0	0	-0.2	1	2	6	7	3	2.5	2.2	0.9
2	14	7	7	5	5	0	0	-0.4	2	3	6	7	3	2.0	1.8	0.6
3	11	10	7	6	9	0	25	0.2	3	4	6	7	3	1.5	1.4	0.3
4	2	2	4	5	2	1	4	0.0	4	5	6	7	3	1.0	1.0	0.0
5	2	4	2	1	5	5	2	0.1	5	6	6	7	3	0.5	0.6	-0.3
6	23	25	20	13	4	4	4	-1.0	6	7	6	7	3	0.0	0.2	-0.6
7	2	3	7	6	13	3	4	0.1	7	8	6	7	3	-0.5	-0.2	-0.9
8	31	26	24	16	27	14	9	-0.5	8	9	6	7	3	-1.0	-0.6	-1.2
9	4	12	10	8	7	4	13	0.0	9	10	6	7	3	-1.5	-1.0	-1.5
10	0	1	3	1	36	50	44	2.5	10	1	6	7	3	-2.0	-0.4	-0.8

1) = Slope (m) of the least squares regression line

(I) =	9.2	9.4	9.1	6.2	11.1	8.1	10.5	0.07	5.5	5.5	6.0	7.0	3.0			
B_p =	9.2	9.3	9.2	8.5	9.0	8.9	9.1									
A_p =									5.5	5.5	5.7	6.0	5.4			
$\sum m_i$ =			-0.05	-0.93	0.14	0.05	0.07	0.07						0.25	0.50	-0.35
S_m =	Standard deviation of the pool regression slopes							0.94						1.51	1.08	0.79
√# of pools =		3.16228	5.47723	6.32456	7.07107	8.36660										
S_b =	Standard deviation using individual pool counts						10.5									
S_{bp} =	Standard deviation using annual pool counts						1.6									

Table 3 continued:

Test 1: First Year Catastrophic Decline using Pre-Project Data

Where: (I) = average number of fish/pool for current year.

(B_p) = average number of fish/pool observed pre-project conditions = 9.1 fish/pool

Catastrophe: (I_{2011}/Bp_{2010}) < 0.25 = < 2.3 fish/pool

Test 2: Subsequent Year Project Operational Catastrophic Decline using Post-Project Data

Where: (I) = average number of fish/pool for any given year.

(Ap) = average number of fish/pool observed prior to the current survey.

Catastrophe: (I_{2012}/Ap_{2011}) < 0.25; or for any combination of current year and prior post-project mean

Test 3: Positive Population Trends (Operational Years 3 and 4)

The test compares the average of the slopes of the regression line for each pool

Positive increase = regression slope greater than zero (*P* = 0.10).

Students' T-test is subsequently used to compare the slope averaged for 30 or 40 pools depending upon the year tested (Year 3 or 4).

For each pool use linear regression analysis (Y = mX + b)

Where: Y = number of fish

X = Year

m = slope coefficient for each pool

S_m = Standard Deviation of the slopes

Use a single sample t-test for the mean slope versus a slope of zero.

$$t = \frac{[(\sum m_i) / \#\text{ of pools}] - 0}{S_m / \sqrt{\#\text{ of pools}}}$$

Determine critical t value using a table of t-distributions with DF = (# of pools)-1, and a 1-tailed *P* = 0.10.

If *t*-calculated is greater than *t*-critical, a significant difference exists and it can be concluded that a significant

Test 4: Negative Population Trends [Preceeding 5 Years]

Test compares the the annual average of the regression slopes of number of fish per pool

Negative decrease = regression slope less than zero (*P* = 0.10)

Use Students' t-test; same as for Test 3, only looking for significant decreases.

Determine critical t value using a table of t-distributions with DF = (# of pools)-1, and a 1-tailed *P* = 0.10.

If the absolute value of negative *t*-calculated is greater than *t*-critical, a significant difference exists and it can be concluded that a significant negative population trend has developed.

Test 5: Comparison of 1-yr Catasrophe with Pre-Project Baseline Population

This test is used only after a 1st-Yr Catastrophic Decline defined in Test 1 has occurred.
Compares post-Project population numbers with pre-Project baseline.

If post-Project is not significantly less than pre-Project mean of 9.1 fish/pool, the population is considered to have rebounded from the earlier catastrophic decline.

Where: (I) = average number of fish/pool for current year.

(B_p) = average number of fish/pool observed pre-project conditions = 9.1 fish/pool

(S_b) = standard deviation of pre-project population using individual pool counts = 10.5 fish/pool

S_b is the within pool mean-square error determined using a one-way ANOVA with DF = 60 [10 pools (7 years -1)].

Single-sample Students' T-test is subsequently used to compare the mean pre-project population (Bp) of 9.1 fish/pool versus the average number of fish per pool for the current year (I).

Determine critical t value using a table of t-distributions with DF = (# of pools) *(n-1), and a 1-tailed *P* = 0.10.

If *t*-calculated is greater than *t*-critical, a significant difference exists and it can be concluded that the population has not rebounded to pre-project levels.

	Example Tests 1 & 2 using 1994/2009 data as potential declines														
Test 1:		0.68		0.89			0.61								
		FALSE		FALSE											
Test 2:								1.00	1.09	1.24	0.50				
Test 3:	Exp. Test 3 using Baseline data					0.659						0.522	1.464		Result; t-calculated
	Critical Value of the t-Distribution			=		1.296						1.311	1.304		Critical Value of the t-Distribution; t-critical
Test 4:														-1.400	Result; t-calculated
	Critical Value of the t-Distribution			=										1.299	Critical Value of the t-Distribution; t-critical
Test 5:	Example Test 5 using 2010 data				-1.051			2.872	2.471	1.670	4.874				Result; t-calculated
	Critical Value of the t-Distribution			=	1.292			1.291	1.290	1.289	1.288				Critical Value of the t-Distribution; t-critical

As shown in the attached Excel file (Table 3), the slope of the fish abundance data per individual pool (l) is variable. Some pools show increasing trends while others show decreasing trends. During both 2009 and 2010, the streamflow in the lower alluvial portion of the monitoring reach, specifically pools 1 through 4, went subsurface for a two to four week period during the summer. The overall summary for all pools shows the most recent slope coefficient of the least-square regression line (m) is averaging 7 percent higher abundance than data collected early in the baseline period (Figure 18). However, the current trout abundance estimates do not show a statistically significant positive trend in the annual survey data from 1991 to 2010. This result implies the Youngs Creek trout population index has been relatively stable over the baseline period.

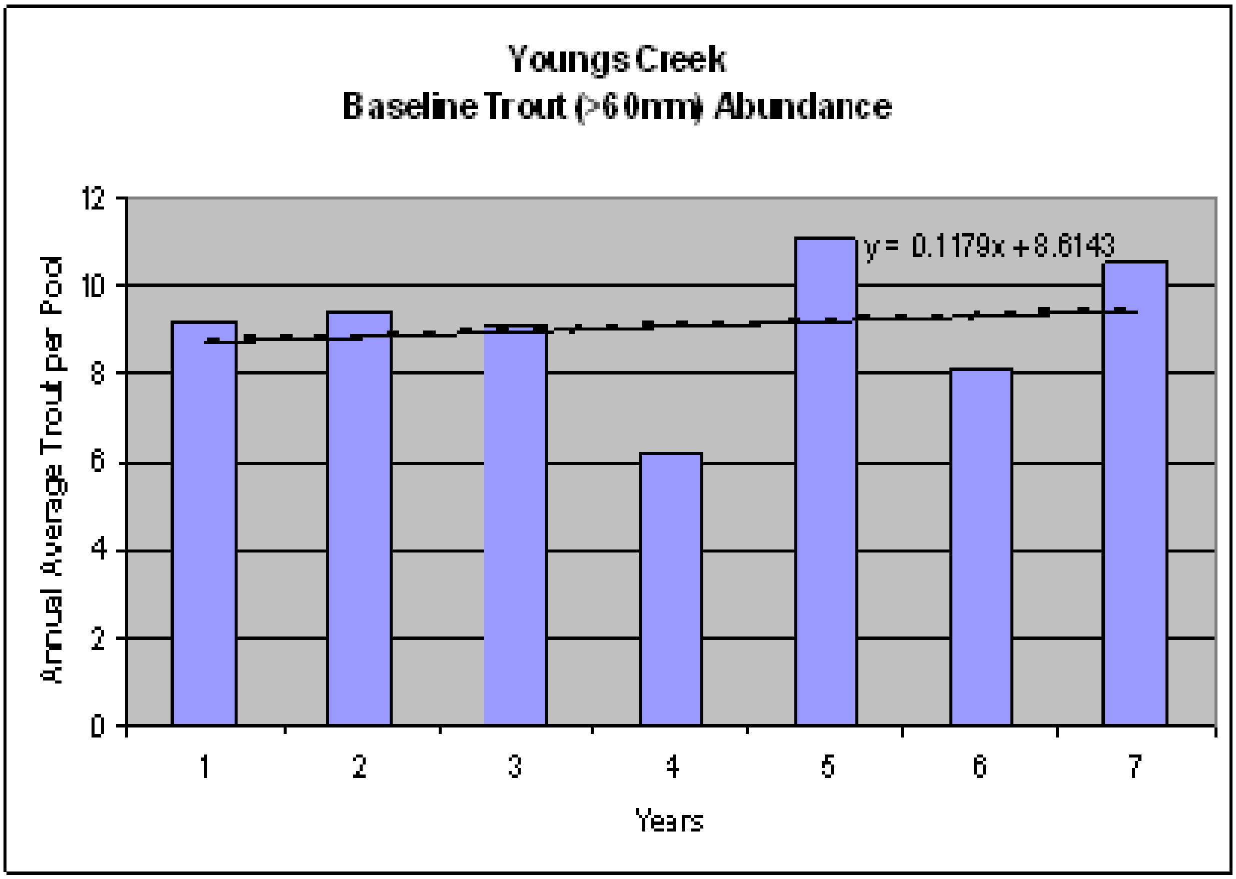

Figure 18. Youngs Creek average annual baseline trout abundance index and least-squared regression trend line (1991 – 2010).

Please contact Keith Binkley (PUD biologist) at KMBinkley@snopud.com if you have any questions about the data collected to date and how they apply to the Resident Trout Monitoring Plan.

Appendix A

Consultation Documentation

Presler, Dawn

From: Presler, Dawn
Sent: Monday, October 04, 2010 2:14 PM
To: 'Applegate, Brock A (DFW)'; 'Tim_Romanski@fws.gov'
Cc: Binkley, Keith
Subject: Youngs Creek (P10359) - 2010 data/pre-project resident trout monitoring report
Attachments: P10359_ResidentTrout2010.pdf; Resident Trout Monitoring Plan_Beak_Nov1993.pdf

Hi Tim and Brock,

Attached is the Youngs Creek Resident Trout Monitoring Plan annual survey report detailing the 2010 data and Pre-Project summary data. Please take the next 30 days to review and provide comments, if any, back to me and Keith by November 3. We can set up a quick conference call to go over the data prior to the comments due date if you would like – just let me know if you are interested in a meeting. Thanks!

(I've also attached the FERC-approved Resident Trout Monitoring Plan for background.)

Dawn Presler
Relicensing Specialist
Jackson Hydro Project

Snohomish County PUD No. 1
PO Box 1107 Everett, WA 98206-1107
Phone: 425-783-1709

Presler, Dawn

From: Applegate, Brock A (DFW) [Brock.Applegate@dfw.wa.gov]
Sent: Friday, November 05, 2010 9:36 AM
To: Presler, Dawn; Tim_Romanski@fws.gov
Cc: Binkley, Keith; Whitney, Jennifer L (DFW); Hoffmann, Annette (DFW); Everitt, Bob (DFW); Hunter, Mark A (DFW); Brock, David W (DFW); Bails, Jamie L (DFW)
Subject: Youngs Creek Hydroproject (P10359) - 2010 data/pre-project resident trout monitoring annual report for 2010 comment letter
Attachments: Resident Trout Monitoring Plan 2010 Annual Report comment letter.pdf

Hi Dawn and Keith, Just a quick note stating that we don't have any comments for the annual report. Thanks for sending it. Please see attached letter stating that we have no comments.

Sincerely, Brock

Brock Applegate
FERC Hydropower Mitigation Biologist
Washington Department of Fish and Wildlife
P.O. Box 1100
111 Sherman St. (physical address)
La Conner, WA 98257-9612

(360) 466-4345 x254
(509) 607-9957 (cell)
(360) 466-0515 (fax)

From: Presler, Dawn [mailto:DJPresler@SNOPUD.com]
Sent: Monday, October 04, 2010 2:14 PM
To: Applegate, Brock A (DFW); 'Tim_Romanski@fws.gov'
Cc: Binkley, Keith
Subject: Youngs Creek (P10359) - 2010 data/pre-project resident trout monitoring report

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Dawn Presler
Relicensing Specialist
Jackson Hydro Project

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PO Box 1107 Everett, WA 98206-1107
Phone: 425-783-1709

State of Washington
Department of Fish and Wildlife
P.O. Box 1100, 111 Sherman St. (physical address), La Conner, Washington 98257-9612

November 5, 2010

Public Utility District No. 1 of Snohomish County
Dawn Presler, Relicensing Specialist
PO Box 1107
Everett, WA 98206-1107

Subject: Youngs Creek Hydroelectric Project (FERC No. P-10359) — Resident Trout Monitoring Plan Annual Report, 2010 Survey and Results of Pre-Project Monitoring

Dear Ms. Presler:

The Washington Department of Fish and Wildlife (WDFW) has reviewed the Resident Trout Monitoring Plan Annual Report for 2010. We have no comments. WDFW has participated in continuous consultation with Public Utility District No. 1 of Snohomish County (PUD). WDFW appreciates the report on the PUD's survey activities and results. We look forward to further collaboration with the PUD and other Aquatic Resource Committee (ARC) members.

Thank you for sending us the annual report for our review. If you have any questions or need more information or clarification from the WDFW, please feel free to call me at (360) 466-4345 x254.

Sincerely,

Brock Applegate
Fish and Wildlife Biologist

Cc: Jamie Bails, WDFW Mill Creek
David Brock, WDFW Mill Creek
Bob Everitt, WDFW Mill Creek
Annette Hoffman, WDFW Mill Creek
Mark Hunter, WDFW Olympia
Jennifer Whitney, WDFW Mill Creek