STREAM ENRICHMENT OF VANCOUVER ISLAND'S UPPER SALMON RIVER INCLUDING GRILSE CREEK, MEMEKAY RIVER, and PATERSON CREEK, 2003

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EXECUTIVE SUMMARY

From June 17 to the end of August, 2003, inorganic fertilizer was added to the Salmon River (Kelsey Bay), Grilse Creek, and the Memekay River for the enhancement of winter-run steelhead (*Oncorhynchus mykiss*) and coho (*O. kisutch*). A total of 2,280 L of liquid fertilizer, ammonium polyphosphate (10-34-0), was dispensed through five drip stations: Grilse Creek – 208 L, Salmon River near Rock Creek Main Line – 724 L, Salmon River fish screen – 516 L, Salmon River at Memekay Main Line bridge crossing – 520 L, and the Memekay River – 312 L. Fertilizer loading rates were adjusted to changing streamflow throughout the treatment period. Water samples were collected July 15, August 12 and September 7, 2003 and analysed at PSC Analytical Services in Burnaby for low level nitrogen and phosphorus.

A new product, providing organic instream nutrients, was tested in Paterson Creek in 2003. The product was made from organic fish meal (Alaskan pollock), heat-treated to remove pathogens, dried, and pressed into 4 kg logs. This product was developed under the guidance of Dr. Ken Ashley of the Ministry of Water, Land and Air Protection, Fisheries Research Section, Vancouver. Water samples were collected and analysed for nitrogen and phosphorus, and periphyton was sampled and analysed for chlorophyll *a* and phaeophytin *a*.

Juvenile fish sampling in treated and control reaches confirmed there was a positive growth response to both the liquid nutrient addition, and the pollock logs.

ACKNOWLEDGEMENTS

Funding in part was provided by the BC Hydro Bridge-Coastal Fish and Wildlife Restoration Program to operate project work for sites upstream of the Salmon River diversion dam including Grilse Creek. Sites below the dam and in the Memekay River and Paterson Creek were funded by Weyerhaeuser's Renewal Investment Corporation. Craig Wightman, Ministry of Water, Land and Air Protection (MWLAP), Nanaimo, supervised the project work. Ken Ashley and Pat Slaney, Fisheries Research Section, MWLAP, produced the spreadsheet for fertilizer addition rates. Ken Ashley provided the pollock logs. The B.C. Conservation Foundation (BCCF) in Nanaimo administered this project under the supervision of Pat Stephenson. Leian Carswell assisted with fieldwork including set-up and dismantling of drip-stations. Harlan Wright provided supervision of the pollock log application and supervised juvenile fish sampling of sites within control and treatment areas. Harlan reported all juvenile fish sampling data and information. MWLAP, Campbell River, under the direction of Dan Dwyer, provided storage space for fertilizer and related equipment. Lynne Campo and Lauren Wick of Water Survey of Canada, Vancouver, supplied the stream discharge data. Quinsam Hatchery provided freezer storage for the pollock logs. This report was edited by Craig Wightman.

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

LIST OF APPENDICES

1.0 INTRODUCTION

The spring and summer of 2003 marked the fifteenth consecutive year of inorganic nutrient addition in the upper Salmon River watershed (Kelsey Bay). Past years have been reported in Perrin, 1989-91; Carswell, 1992-3; and Hansen, 1994-5, 1999a-d, and 2001-03. This stream enrichment project is designed to enhance the growth and survival of juvenile steelhead (*Oncorhynchus mykiss*) and coho (*O. kisutch*) through increased periphyton accrual and subsequent increases in the invertebrate food supply. Hatchery-reared steelhead fry, progeny of wild Salmon River broodstock, were released into the upper Salmon River and Grilse Creek from 1986 to 1998. The fry were reared at the province's Vancouver Island Trout Hatchery in Duncan. In addition, numbers of wild steelhead in the upper watershed have increased following the construction and operation of the fishway at the BC Hydro diversion dam in 1992. The first year of operation of the fishway (winter 1992/93) allowed adult steelhead to migrate upstream of the diversion dam. Counts of downstreaming kelts at the fish screen and trap in 1998 and 1999, supported by snorkel surveys, indicated that steelhead escapement to the upper Salmon River above the diversion dam was well established. No wild steelhead broodstock was taken after 1998. Enumeration of downstream migrating juveniles has been conducted at the Salmon River fish screen (located in the diversion canal) since 1987, and summarized in contract reports beginning in 1989 (Perrin 1989; Carswell 1990 to 1993 inclusive; Hansen 1994; Hansen & Rimmer 1995; and Hansen 1997 to 2003, inclusive).

Development of a slow-release fertilizer has been undertaken by the Fisheries Research and Development Section, Ministry of Water, Land and Air Protection (MWLAP), Vancouver, B.C. and supervised by Dr. Ken Ashley. Field trials to study the instream application of solid inorganic fertilizer in Salmon River tributaries were initiated in 1995 and continued each season to 1997 inclusive (Mouldey Ewing et al. 1996-8). In 2002, another experimental product, a struvite-coated urea granule, was applied to the upper Salmon River just below the Jessie Creek confluence (Hansen 2003). An organic product made from Alaskan pollock bone meal was developed for initial testing in 2003.

A chronology of stream fertilization treatment in the Salmon River watershed, including Grilse Creek from 1988 to 2002, is detailed in Appendix 1. This was also the seventh year of stream nutrient addition to the Memekay River.

Funding for 2003 was provided by the BC Hydro, Bridge Coastal Restoration Program and Weyerhaeuser's Renewal Investment Corporation. All costs pertaining to sites upstream of the Salmon River diversion dam were covered by BC Hydro and all costs for sites below the dam and in Paterson Creek were covered by Weyerhaeuser.

2.0 MATERIALS AND METHODS

2.1 Site Locations (Tanks)

Five drip-sites for the addition of liquid 10-34-0 were operated in the Salmon River watershed in 2003. A location map is provided in Figure 1. Two of the five drip-sites were located upstream of the BC Hydro Salmon River diversion dam. The first site provided nutrient addition to Grilse Creek at the upper bridge crossing on Grilse Creek Main Line (ML) just below the old Reliable logging camp. The second site provided nutrient addition to the mainstem Salmon River, and

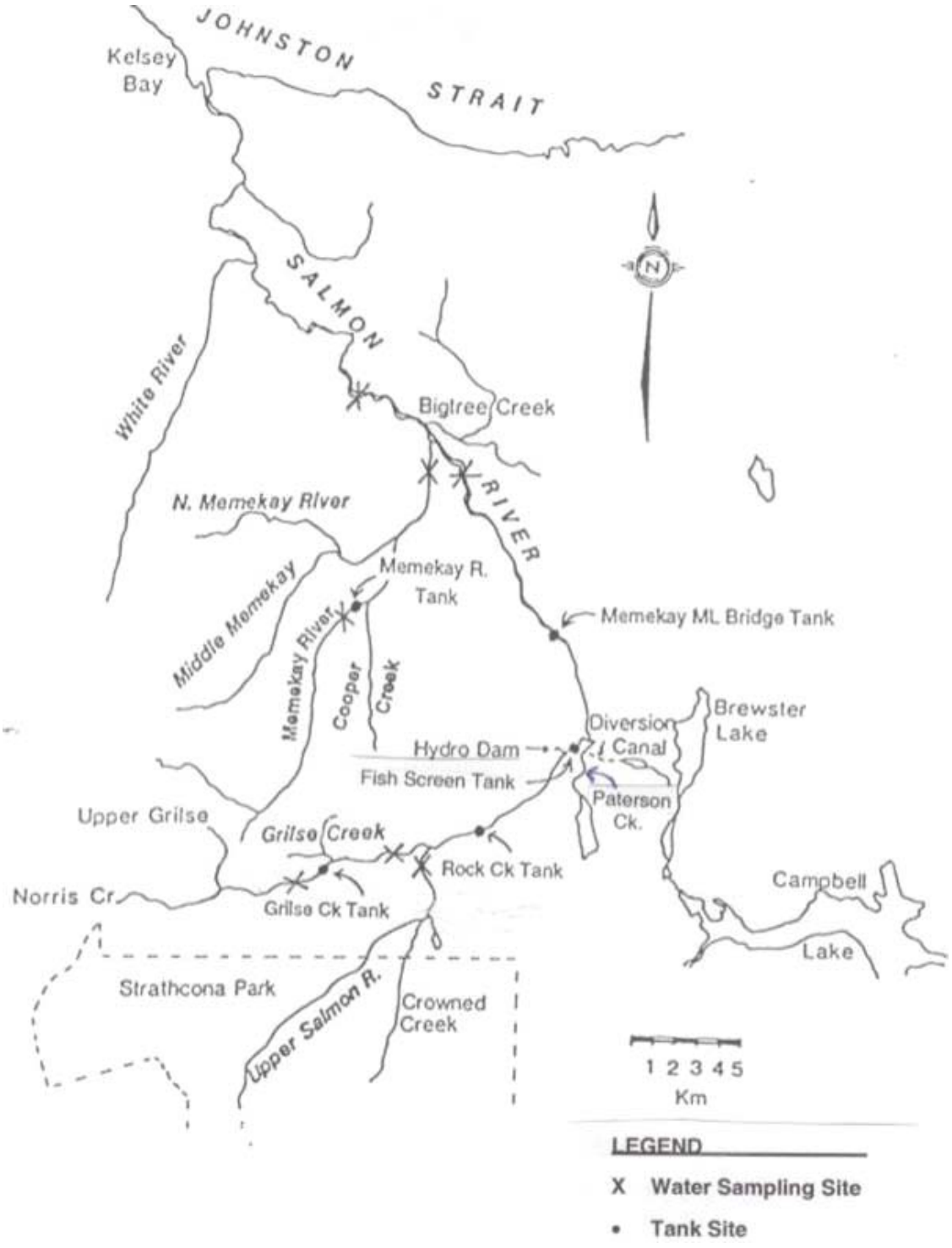


Figure 1. Location of the fertilization area showing liquid fertilizer tank sites and sampling sites on the mainstem Salmon River, Grilse Creek, and the Memekay River in 2003.

was located 1 km upstream of the deactivated Rock Creek ML bridge crossing. Drip-sites below the diversion dam included two additional sites on the mainstem Salmon River, one at the Salmon River bridge crossing adjacent to the diversion fish screen and a site at the Memekay ML bridge crossing. The fifth site was located on the Memekay River, at the Memekay ML bridge crossing and accessed from a short spur road on the west side of the bridge. These locations were accessible by logging roads of Weyerhaeuser Canada Ltd., North Island Timberlands (Figure 1).

2.2 Water Temperatures and Flow Monitoring

Spot water temperatures were noted each day the drip stations were calibrated or samples collected. Continuous water temperature data were recorded using StowAway® Tidbit® Loggers (Onset Computer Corp.) measuring every 10 minutes +/- 0.1 °C (Onset, 1996-1998). Data loggers were operated at the Grilse Creek site, Salmon River at the Rock Creek ML site, the Salmon River control sample site, and the Pallan's site. A datalogger was also set in the Memekay River, however, the settings were incorrect and only 10 days of readings were collected.

Daily discharge for the upper Salmon River was obtained from the BC Hydro DCP (data collection platform) website, (http://eww.bchydro.bc.ca/info/res_hydromet/data/sam.txt). Discharge was read telemetrically from the gauge at the Water Survey of Canada (WSC) site #08HD015, above the diversion dam. To calibrate the downstream tank on the Salmon River (at the Memekay ML Bridge), daily discharge at the gauging station, #08HD007, was read from the website (http://eww.bchydro.bc.ca/info/res_hydromet/data/mky.txt). The preliminary mean daily discharges for the period June 1 to September 30, 2003 were provided by WSC, Vancouver. Streamflow was measured in Grilse Creek, the Memekay River and Paterson Creek using a Marsh-McBirney streamflow meter, model 201.

2.3 Installation of Tanks

Polyethylene tanks were placed at stream-bank locations accessible by vehicle, but placed out of view of road traffic. Information signs were posted beside each tank describing the enhancement goal and the sponsoring government agency. Each tank was set fully supported on smooth ground and slightly angled toward the outlet valve (Figure 2). A 1-inch or 3/4 inch PVC ball-valve was installed at the outlet of each tank with Teflon tape to ensure a complete seal. The seal was tested before filling the tank with fertilizer. Each valve outlet was fitted with a fine-mesh in-line filter to remove solid and colloidal material. A stainless steel low-volume output valve was installed on each tank (for fine control of the drip-rate) (Figure 3). A length of 12 mm (I.D.) polyethylene hose was attached to apply fertilizer directly to the wetted stream channel and, where possible, into the thalweg. At suitable locations, the output end of the hose was attached to a steel tripod to dispense the drip at the surface of the water to allow for immediate mixing into the streamflow.

Figure 2.
The fish screen tank site under the Salmon River ML Bridge, 2003. Tank capacity is 624 L.

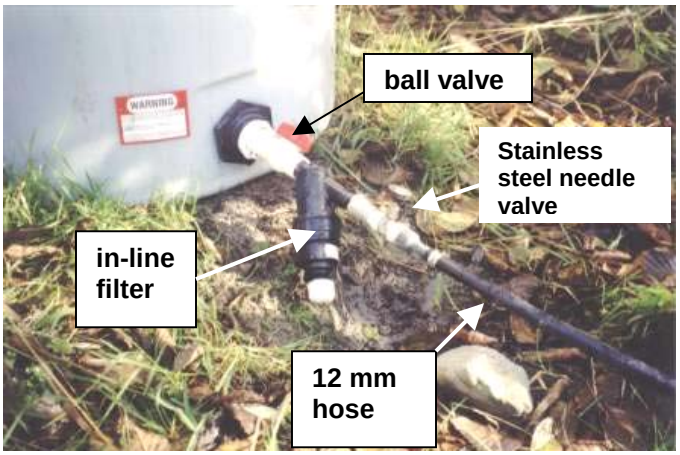


Figure 3.
The valve system installed on all tanks.

2.4 Liquid Fertilizer Acquisition and Tank Loading

The fertilizer, liquid ammonium polyphosphate, was purchased from TerraLink Horticulture Inc. in Abbotsford. The barrels were stored in the Ministry of Forests compound in Campbell River. Each barrel contained 208 L of fertilizer, with a density of 1.40 kg/L. Fertilizer specifications (by weight) were 10% N, and 34% P_2O_5 (10-34-0). The mix contained 14.85% P.

The fertilizer was pumped from barrels in storage into empty barrels in the transport vehicle and driven to the sites. A small gas-operated pump was used to download the fertilizer into the drip tanks. Once filled, the tank load needed to settle (24 hours) before a reliable drip-rate could be maintained. The in-line filters were checked periodically and cleaned if necessary. Tanks and equipment were removed, cleaned, and returned to storage at the end of the season.

2.5 Calibration of Liquid Fertilizer Additions

Head reduction in the tank, variations in humidity, and air temperature affect drip-rates; therefore, tanks were calibrated every few days. Stream discharge for the Salmon River was estimated using information from the gauge stations at the BC Hydro diversion dam (#08HD015) and above the Memekay River confluence (#08HD007). Stream discharge was also measured in Grilse Creek and the Memekay River on five occasions through the summer. Tanks were calibrated using measured and estimated streamflow. Target rates were determined from tables provided by K. Ashley and P. Slaney (Fisheries Research Section, MWLAP) shown in Appendix 2. The output of each tank was measured in ml/min and recorded. Drip-rates were then re-calibrated to match the target rate of 5 μg/L soluble reactive phosphorus (SRP).

2.6 Organic Fertilizer Experiment (Pollock logs)

On June 11, 2003, 17 pollock logs were placed in Paterson Creek near the ML bridge. The loading rate was calculated using an estimated discharge value of 0.8 m^3/s (Harlan Wright, pers. comm.). No water or periphyton samples were collected. Visual assessment was maintained to determine the length of time the pollock bone meal remained at the application site.

On July 9, after the majority of the original placement had disappeared, 2 pollock logs were placed in the creek at the same location as the original placement. The loading rate was calculated using an estimated discharge of 0.1 m^3/s (Harlan Wright pers. comm.). On the same day (July 9), periphyton blocks were placed in the control reach upstream of the placement (Paterson – Control), 66 m downstream of the July 9 placement (Paterson – T100), and approximately 400 m downstream of the log placement (Paterson – T400). Periphyton and water samples were collected.

Each pollock log contains 17.6% P_2O_5 or 7.7% P (P_2O_5 is 43.7% P) (Harlan Wright, pers. comm.). The following example calculation shows the loading rate of pollock logs based on a streamflow dilution of 0.8 m^3/s.

Loading rate for pollock logs (adapted from Megan McCusker's calculations for slow release product):

Water discharge during fertilization period=					
Average flow ($m^3 \cdot sec^{-1}$)	$Sec \cdot day^{-1}$	Days	$L \cdot m^{-3}$	Litres of water	
0.8	86,400 x	30 x	1000	**= 2.07×10^9**	
Kilograms of pollock needed =					
Target concentration. ($\mu g \cdot L^{-1}$ P)	(μg fertilizer)$\cdot$ (μg P)$^{-1}$	$kg \cdot \mu g^{-1}$	Litres	Kg of fertilizer needed	# of Logs$\cdot$ (Kg of Fertilizer)$\cdot(4^{-1)}$ *
2.5 x	1/0.077 x	1×10^{-9} x	2.07×10^9	= **67.32 kg**	**= 17 logs**

***** Each pollock log weighed approximately 4 kg.

On September 24, 2003, the remaining pollock logs in freezer storage at the Quinsam Hatchery, were placed in Grilse Creek at five sites. The stream discharge, measured the same day with a Swoffer current velocity metre, model 2100 was 0.37 m^3/s. Some of the logs were placed in the water in suitable locations and the rest of the logs were placed just above the water level to provide additional nutrient loading once the water level increased. Loading was as follows (data provided by Harlan Wright):

Site	# of logs		
	Dry	Wet	Total
1. upper Grilse Cr. Bridge (old camp)	10	21	31
2. culvert 300 m downstream of **1.**	11	5	16
3. 500 m upstream of SFK bridge	8	8	16
4. SFK bridge	7	1	8
5. 1.5 km upstream of SFK bridge	44	8	52
Total	80	43	**123**
note - most dry logs were placed within 5-10 cm above the water level.			

2.7 Water Sampling

Water chemistry samples were collected in 1 L plastic bottles supplied by PSC Analytical Services. The bottles were rinsed three times with stream water in the field before being filled with sample water. For low-level nutrient samples, 100 ml sterile brown-glass bottles were used, provided by PSC. Stream water was field-filtered through a 0.45 μm cellulose acetate disposable filtration unit using a 60 ml syringe. The syringe was rinsed with stream water before being filled with the sample water. The sample bottle was rinsed with filtered stream water before filling. The samples were packed with ice in a cooler and shipped by courier to the lab within 24 hours.

Water Sample Sites - Liquid Fertilizer Application

The sample sites for liquid fertilizer applications are shown in Figure 1 and described as follows:

Grilse Creek:

Grilse Creek control – 0.8 km upstream of the Grilse Creek ML bridge crossing, accessed along a small ephemeral tributary.

Grilse Creek bridge – just above the lower bridge on South Fork (SF) ML, accessed from the south side approximately 100m west along SF-B.

Salmon River mainstem:

Salmon River control – at the bridge washout on the SF-A spur.

Salmon River- WSC – at the WSC site at the end of the BigTree- 2 (BT-2) spur.

Salmon River Pallan's – the old Pallan's bridge site, opposite bank from Spur DY-R.

Memekay River:

Memekay River control – just upstream of the drip station at the Memekay ML bridge.

Memekay River bridge – just downstream of the bridge crossing on Airstrip Road.

Water Sample Sites - Pollock Log Test

Water sampling in Paterson Creek was conducted at three sites. These were:

Paterson Control – 20 m upstream of the pollock log placement

Paterson T100 – 66 m downstream of the pollock log placement

Paterson T400 – approximately 400 m downstream of the log placement

2.8 Periphyton Sampling in Paterson Creek

Periphyton blocks were placed at three sample sites in Paterson Creek. Blocks consist of a sheet of white florist's foam, 1.25 cm thick, attached to Plexiglas plates with electrical ties. The plates were bolted to concrete blocks and placed in the stream, tipped slightly into the direction of flow. Rocks were placed around the block edges for extra stability. Each block was submerged under at least 12 cm of water to allow for decreasing streamflow. Each site location was selected to approximately replicate similar solar exposure, water depth, and water velocity.

Using a 7 dram plastic vial, two cores of foam (each 2.7 cm in diameter and 5.73 cm^2 area) were punched out of each periphyton block (Mouldey Ewing et al.) (Figure 4). Each sample was drained and placed in the vial. The vial was vented with holes through the cap to allow the sample to dry. The vials were placed in a sealed, light-proof container with desiccant, and kept cool with ice. The samples were frozen as soon as possible. Samples were taken at 1, 2, 3, 4, 5 and 6 weeks. The foam was replaced immediately after the 6-week sample was taken and samples of the new foam were collected at 1, 3, and 5 weeks. At the end of the sampling period, all samples were shipped frozen, in a cooler with dry ice, to the lab. The samples were measured for chlorophyll *a* and phaeophytin *a* in $\mu g \cdot cm^{-2}$.

Figure 4.
Periphyton block placed in Paterson Creek at the control site showing 4 weeks of growth and the August 6 core samples removed.

2.9 Juvenile Fish Sampling

Juvenile sampling was conducted by the BCCF Steelhead Crew of Nanaimo (and L. Hansen) under supervision of Harlan Wright, in early September, 2003. Ten sites, consisting of treatment areas and controls, were sampled on the Salmon River mainstem, Grilse creek, and the Memekay River.

The following sampling description was provided by the Steelhead Crew.
Sampling was conducted using closed-site electrofishing techniques. At each electrofishing site, about 100 m^2 of suitable steelhead fry habitat (typically cobble/gravel riffles, <30 cm in depth, and <25 cm/sec in velocity) was enclosed with small mesh stopnets, and all fish were removed using the standard, 2-pass removal method (deLeeuw 1981). Lengths were recorded for all fish captured, and 30+ juveniles per species and age class were weighed using Ohaus top loading scales (model CS 200) accurate to 0.1 g. Habitat parameters were documented consistent with current Fisheries Branch techniques (methodology by R. Ptolemy, Rivers Biologist, MWLAP, Victoria), and each site was photographed. Upon removal of the stopnets, a depth/velocity profile across a representative transect within the site was recorded using a Swoffer current velocity meter, model 2100. Population estimates were later derived and depth/velocity profile adjusted using Fisheries Branch habitat suitability index curves. Sites on the Salmon River were chosen to monitor stock abundance in general and also to monitor enhancement by fertilizer additions. (Craig, J. et al. 2001)

Two sites were electrofished without stop nets in Paterson Creek, one upstream from the T-400 sample site (treated) and one approximately 30 m upstream of the control site. Approximately 100 m of habitat was 'spot-shocked' within each reach in order to capture a minimum of 30 steelhead/rainbow fry and 30 coho fry.

3.0 RESULTS

3.1 Water Temperatures and Stream Discharge

Water temperature measurements for the Salmon River, and Grilse Creek are summarized by month in Table 1. Daily mean, minimum, and maximum temperatures are shown in Appendix 3. Dataloggers were placed in the Salmon River at the control sample site, at the Rock Creek ML tank site, and at the Pallan's sample site. A datalogger was placed in Grilse Creek at the tank site. A datalogger was also placed in the Memekay River at the tank site, however, the settings were incorrect and only ten days of measurement were recorded. Spot temperatures were recorded using a hand-held thermometer each day of field work. The results are listed in Appendix 4.

Table 1. Water temperature data collected from Grilse Creek at the upper bridge crossing, the mainstem Salmon River at the control site, the Rock Creek ML tank site, and Pallan's, from late June to September, 2003.

Stream	Month (2003)	Monthly Mean (°C)	Range of Daily Mean (°C)	Minimum Temp (°C)	Maximum Temp (°C)
Grilse Ck.	July	13.0	10.1 – 16.2	9.1	19.3
	August	13.7	11.0 – 16.1	9.7	19.3
Salmon R. Control	July	12.4	9.5 – 15.7	8.6	18.2
	August	14.0	11.9 – 15.6	10.8	19.5
Salmon R – Rock Ck ML	July	13.4	10.5 – 16.8	9.3	19.9
	August	14.9	12.3 – 16.4	11.3	19.1
Salmon R – Pallan's	July	14.9	13.4 – 16.5	12.1	19.2
	August	13.7	11.5 – 15.9	10.6	18.3

The temperature gain for July from the Salmon River control site to the Pallan's site, a distance of approximately 38.6 km, was 2.5 ˚C (monthly mean).

Streamflow measurements for Grilse Creek, and the Memekay River are shown in Table 2. The mean daily discharge (preliminary data) for the Salmon River above the diversion is shown as a comparison. Mean daily discharge data (preliminary) provided by WSC are shown in Appendix 5.

Table 2. Streamflow measurements from Grilse Creek, the Memekay River, and the Salmon River above the diversion in 2003.

Date (2003)	Grilse Ck. (m^3/s)	Memekay R. at SF-A washout (m^3/s)	Salmon R. – WSC (preliminary)	
			above Memekay R. (m^3/s)	above diversion (m^3/s)
June 21	1.33	1.78	4.89	** 6.48
July 5	0.70	1.32	4.94	4.67
July 22	0.56	0.73	3.71	3.62
August 11	0.40	0.64	2.09	1.85
August 21	0.16	0.15	1.21	0.96
Sept. 24	* 0.37		2.53	1.54

* Measured with a Swoffer current velocity meter, model 2100.
** The diversion was shut on June 27, 2003.

Spot water temperatures and streamflow measurements recorded for Paterson Creek are listed in Appendix 6.

3.2 Liquid Fertilizer Output

The total load of 10-34-0 applied at each site over approximately 73 days was as follows: Grilse Creek- 208 L; Salmon River near Rock Creek ML – 724; Salmon River at the fish screen – 516 L; Salmon River at the Memekay ML bridge – 520 L; and the Memekay River – 312 L. The total load for the Salmon River watershed was 2,280 L. The calibrated and output rates of each tank are shown in Appendix 7.

3.3 Pollock Log Applications

The application of 17 pollock logs on June 9 was based on an estimated summer discharge for Paterson Creek of 0.8 m^3/s. This estimate was too high. The measured discharge on June 17 was 0.23 m^3/s. However, within 10 days the volume of pollock meal remaining at the application site appeared to be much reduced. On June 17, only one half of one log was intact. The rest had completely re-hydrated into piles of fish meal. Some had washed away and some had become capped with an algae/fungal growth. It appeared this cap kept some of the fish meal in place longer. Abundant algae growth was evident downstream of the application site. After one month, the majority of the fish meal had disappeared. Two pollock logs were placed at the same site on July 9. Algae growth can be seen in the right side of Figure 5. The remains of a pollock log capped with algae and fungus is shown in Figure 6. White dead algal material can be seen on the rocks.

Figure 5.
Pollock log placed in Paterson Creek, July 9, 2003.

Figure 6.
The remains of a pollock log showing algae growth, 2003 (no date).

3.4 Water Sampling Results of Liquid Fertilizer Treatment.

Growth in June and early July was not as strong as seen in past years of nutrient addition. The first water sample results, from samples collected July 15, indicated extreme nitrogen limitation except at the downstream sites on the Salmon River; WSC and Pallan's. These low levels were measured from the controls as well as the treatment samples. Subsequent sampling indicated no nitrogen limitation and stronger growth was visible. See Figure 7 for results of all nitrogen (nitrate+nitrite) analysis. The first rainfall was noted July 16. The summer was generally very dry, probably causing the nitrogen limitation in the first part of the growing season and the lack of strong algal growth. All water analysis results are presented in Appendix 8.

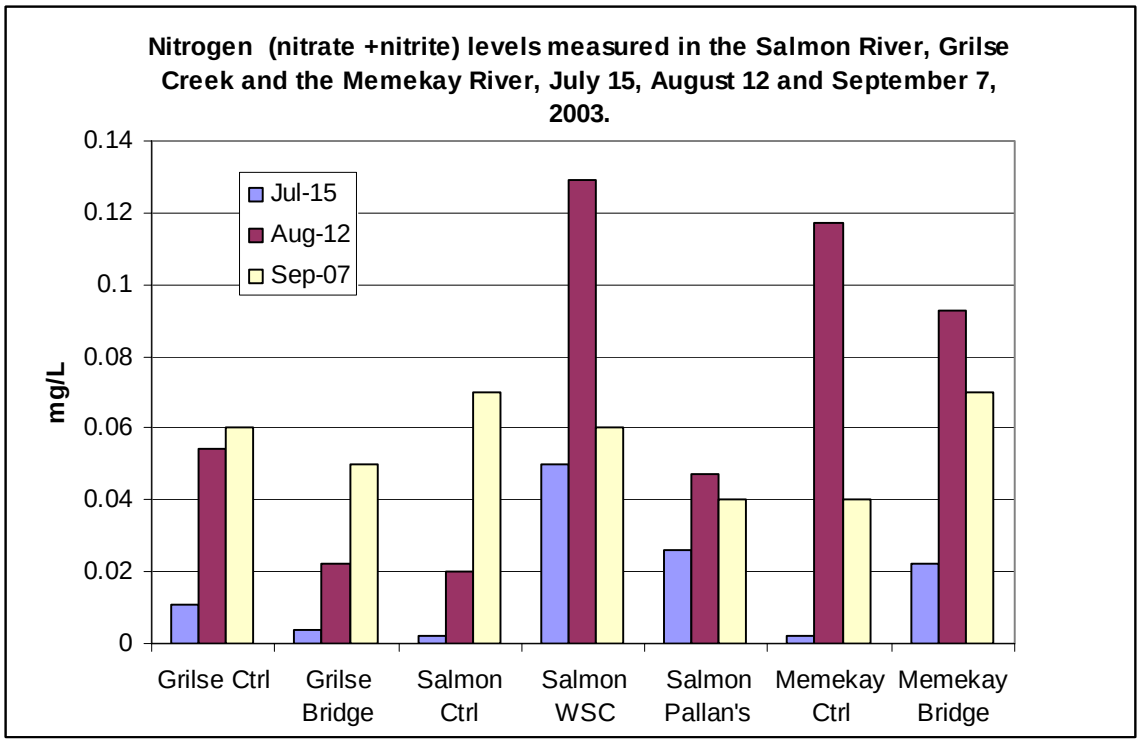


Figure 7. Nitrogen (nitrate+nitrite) levels (mg/L) measured in the Salmon River, Grilse Creek and the Memekay River, July 15, August 12 and September 7, 2003.

3.5 Results of Water Sampling in Paterson Creek (Pollock Log Experiment)

Generally, ammonia nitrogen (N) levels are below the method detection limit (MDL) levels, however, levels of 0.005 and 0.008 mg/L were measured for T400 and T100 respectively, from the July 23 samples. The control water sample was also high, and measured 0.011 mg/L, so this could not be attributed to the pollock fertilizer. Water sample results are listed in Appendix 9.

Nitrogen levels (nitrite + nitrate) were higher in the treatment samples than the control sample until week 9 (Figure 8). (There was no water sample in week 8.)

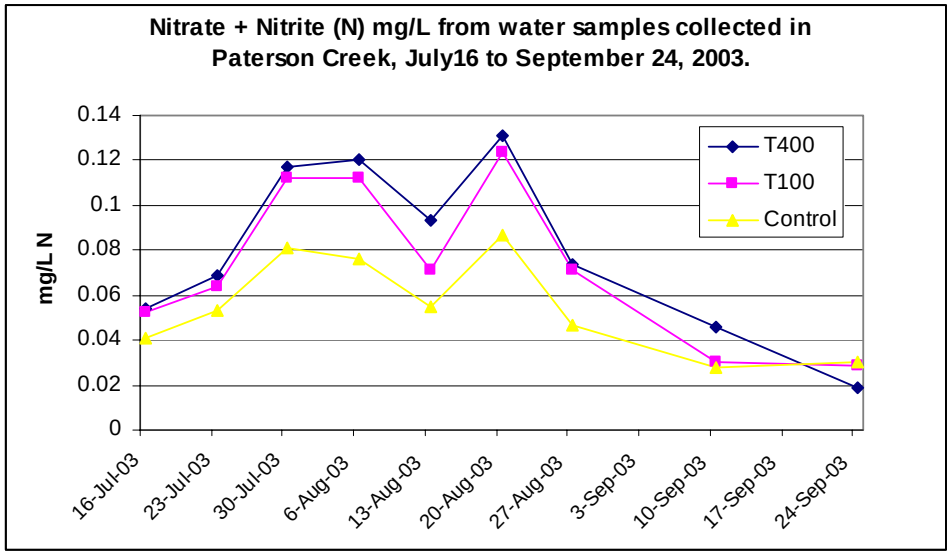
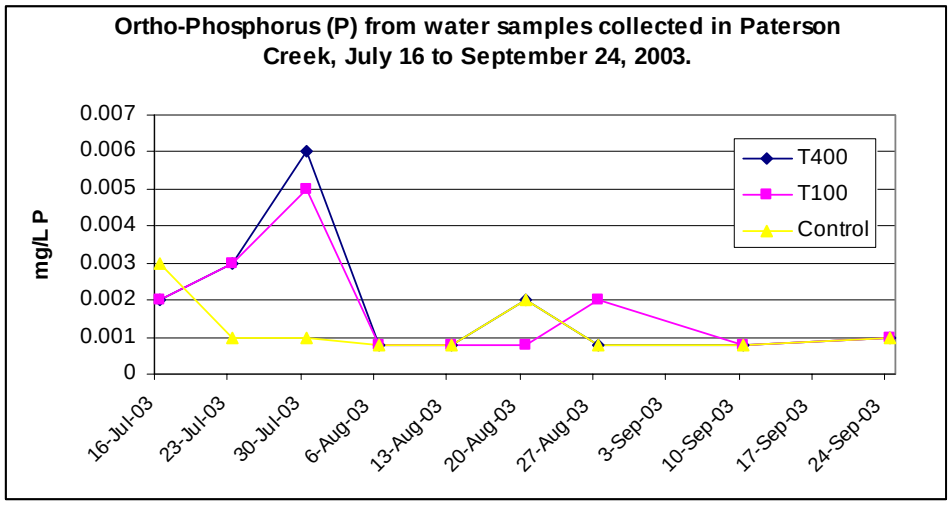


Figure 8. Nitrate + Nitrite (N) mg/L from water samples collected in Paterson Creek, July 16 to September 24, 2003.

The highest ortho-phosphorus levels in the treatment area were measured on July 30, 2003, 20 days after the second pollock log placement (Figure 9). Further testing will be required to determine if this nutrient spike originated from breakdown of the pollock meal.



* Ortho-phosphorus levels below the MDL (<0.001) were given the value of 0.001 for the purposes of charting the values.

Figure 9. Ortho-phosphorus (P) levels (mg/L) from water samples collected in Paterson Creek, July 16 to September 24, 2003.

3.6 Results of Periphyton Sampling in Paterson Creek (Pollock Log Experiment)

The results for chlorophyll *a* levels from the July 9 application of pollock logs in Paterson Creek showed periphyton accrual during the first six weeks was higher in the treatment area than in the control sample (Figure 10). However, this growth effect did not continue into the second test of

six to 11 weeks after the fertilizer application (Figure 11). Very little difference in chlorophyll *a* levels was measured. Little or no nutrient benefit could be credited to the pollock application during the sixth week or later. Complete analysis results are listed in Appendix 10.

Figure 10 shows accrual over time, indicating nutrients available early in the test period are still available through nutrient cycling. Figure 11 shows no difference in availability through accrual in the control site and in the treatment. The T100 site was only 66m downstream of the application. This most likely indicates no significant nutrient provision from pollock logs after 6 weeks (or possibly less).

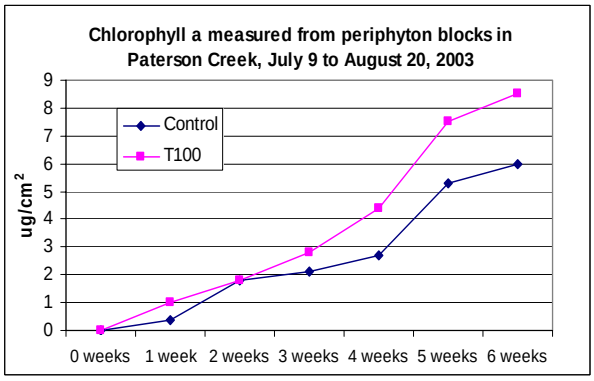


Figure 10.
Chlorophyll levels from periphyton samples comparing control and treatment in Paterson Creek, July 9 to August 20, 2003.

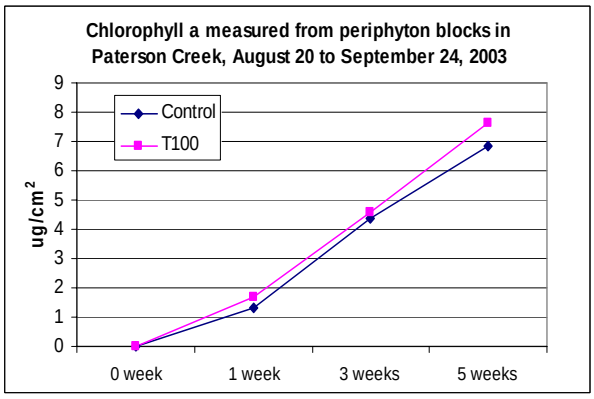


Figure 11.
Chlorophyll levels in Paterson Creek periphyton samples, comparing control and treatment, August 20 to Septenber 24, 2003.

A visual record of periphyton accrual from July 9 to August 6 is shown in Figure 12. The results of chlorophyll *a* and phaeophytin *a* measured from each sample core are shown below the photo. Figure 13 provides a comparison of an additional week of growth to August 13.

Figure 12.
Periphyton samples from Paterson Creek sites compared to clean foam on the left. Three samples on the right showing **four weeks** of growth.

µg/cm^2			
Chlorophyll *a*	2.7	4.37	4.95
Phaeophytin *a*	2.87	5.62	2.3

Figure 13.
Periphyton samples from Paterson Creek sites compared to clean foam on the left. Three samples showing **five weeks** of growth.

µg/cm^2			
Chlorophyll *a*	5.3	7.54	6.83
Phaeophytin *a*	4.15	4.88	3.34

3.7 Juvenile Fish Sampling

Fish sampling results confirmed there was a positive growth response to the liquid ammonium polyphosphate in Grilse Creek. Steelhead fry sampled in the uppermost treated site were 2.6 times larger than those sampled in the un-treated control, 1.3 km upstream (Figure 14). Results of juvenile sampling are shown in Appendix 11.

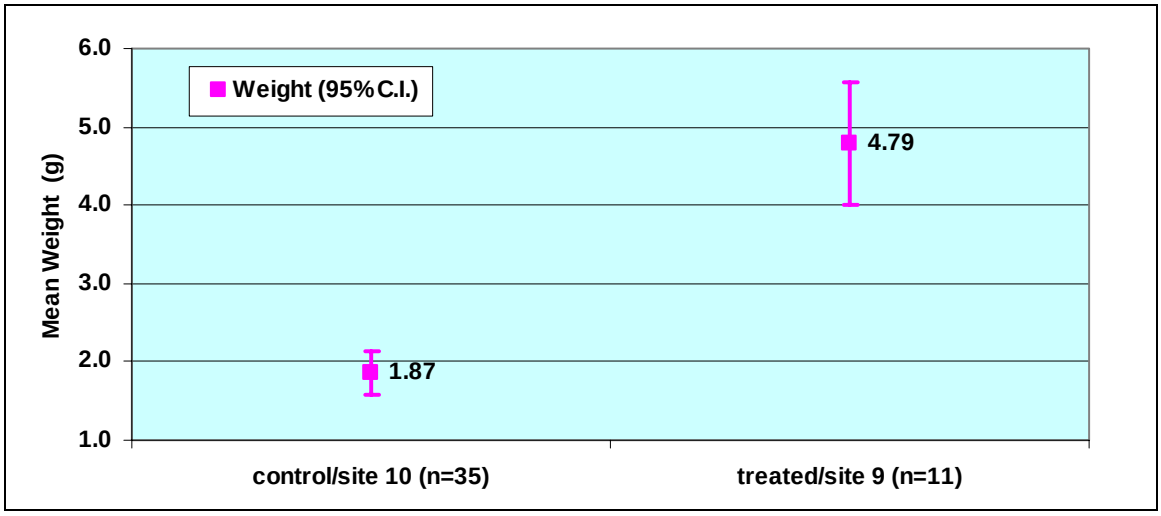


Figure 14. Mean weights of steelhead/rainbow fry captured in Grilse Creek, September 12, 2003.

In Paterson Creek, the mean size of coho fry sampled downstream of the pollock log application site was significantly greater than the mean size sampled in the control (Figure 15). Results for steelhead fry showed very little size difference in the treated vs. the control site. Flows were very low at the time of the survey, thus juvenile densities were very high. Good growth response for coho may be attributed to drought-like conditions favouring 'pool dwelling' coho, at the possible expense of 'riffle dwelling' steelhead (C.Wightman pers. comm.).

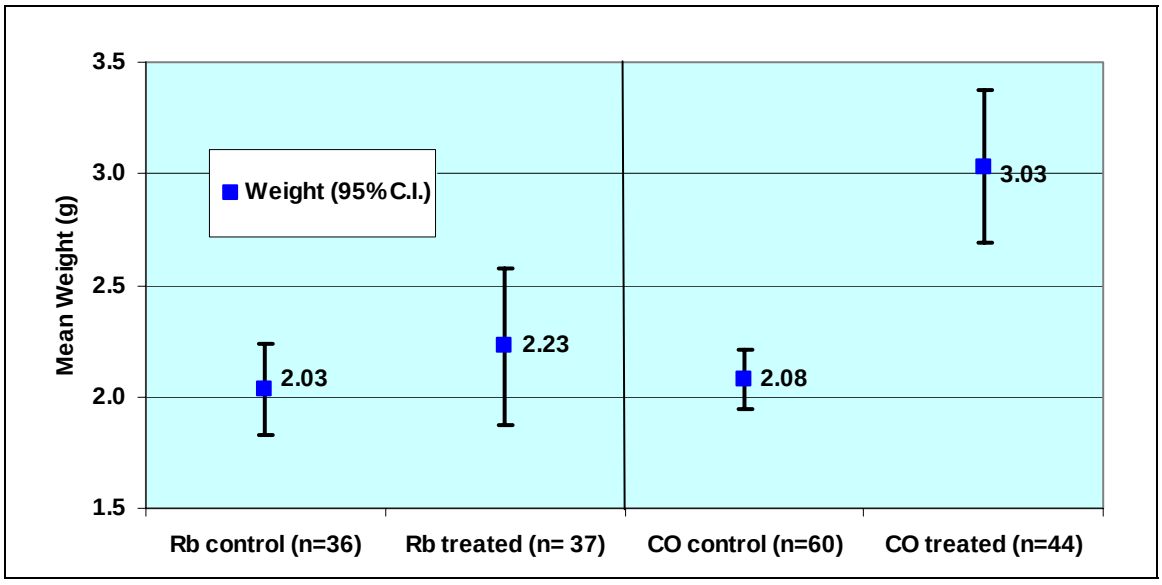


Figure 15. Mean weights of steelhead/rainbow and coho fry captured in Paterson Creek, September 24 and 26, 2003.

Figure 16 compares the estimated biomass of steelhead fry in the Salmon with other streams electrofished by the BCCF steelhead crew in 2003. The Salmon ranks second in terms of biomass sampled per 100m^2 of habitat. This is impressive, considering that results for Quinsam and Little Qualicum include hatchery outplanted fry, and the Cowichan receives nutrient additions from sewage effluent. Relatively high productivity in the Salmon may be linked to 15 consecutive years of nutrient addition.

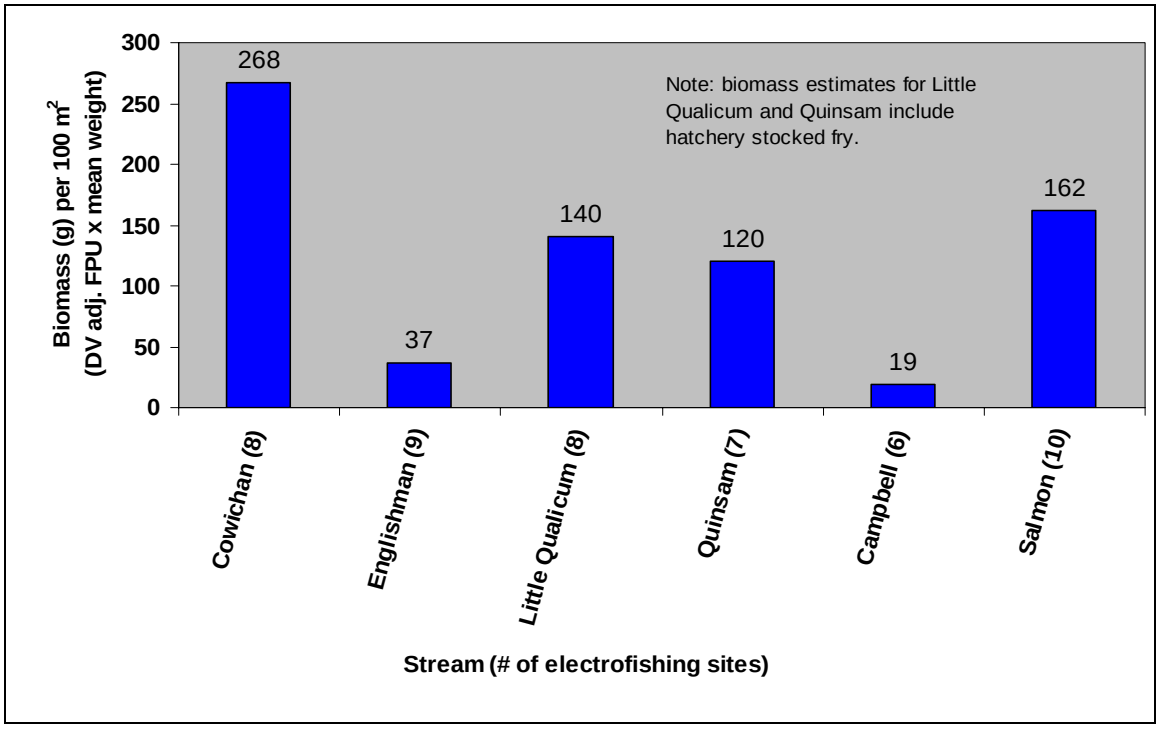


Figure 16. Average biomass of steelhead/rainbow fry sampled by electrofishing in selected east coast Vancouver Island streams, 2003.

4.0 CONCLUSIONS

Liquid Fertilizer Application
During future applications of liquid fertilizer application it would be wise for field personnel to note rainfall events so that nitrogen limitation can be anticipated, if there is little or no rainfall. Water samples could be analysed within one week to confirm this. However, there is an additional lab cost for the faster service. Increasing the drip-rate (above 5 µg/L SRP) is a possible remedy and should be considered.

Pollock Log Application
Testing of the pollock logs was undertaken in 2003 by Sarah Lawrie, under supervision by Dr. Ken Ashley of the Fisheries Research and Development Section of MWLAP in Vancouver. Greg Wilson, Fisheries Biologist, MWLAP, Surrey was the technical advisor. The information gained from the application in Paterson Creek, although not conclusive, will contribute to the assessment of this product.

Photographic records of periphyton growth on the sample cores would be a useful tool in conjunction with chlorophyll *a* and phaeophytin *a* analysis. It is recommended that a quality photo or digital camera with close-up (macro lens) capability be obtained for this purpose. A tripod and light would greatly simplify this procedure and help ensure consistent picture quality. In addition, a polarizing lens for the camera would provide a better quality picture of subjects that are under water.

There is a possibility that bear hazard may increase for field personnel in areas of pollock log application. Although there was no evidence of this during the Paterson Creek test, caution is advised during future applications and field work.

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6.0 APPENDICES

APPENDIX 1.

Salmon River Fertilization Project 1988 – 2002: Chronology of Treatments

The Salmon River fertilization project has been initiated and supervised by the Ministry of Environment, Lands and Parks (MELP), Fisheries Section, in Nanaimo (now Ministry of Water, Land and Air Protection (MWLAP)). Other agencies and contractors involved are listed below, along with specific details of each year of application. Juvenile sampling by electrofishing was carried out every year in the late summer. MWLAP records are computer filed at the Nanaimo office.

Water chemistry analysis included low-level measurement of nitrogen-ammonia, nitrogen-nitrate, total nitrogen, dissolved ortho-phosphate, total dissolved phosphorus, and total phosphorus. In some years, additional tests were conducted. Periphyton samples were collected on artificial substrate and analysed for chlorophyll *a* and phaeophytin *a*. Sample sets were collected at intervals throughout the fertilizer application period.

Pre-fertilization sampling

1988 **Agencies:** MELP, NANAIMO. Contractor: Limnotek Research and Development Inc.
Water chemistry samples: ✔ Five sample sets from 2 sites.
Periphyton samples: ✔ Two series of 3 sample sets over 21 days- from 2 sites.
Taxonomy samples: Algae. ✔
References: Perrin (1989).

Fertilization and Sampling

1989 **Agencies:** MELP, NANAIMO. Contractor: Limnotek Research and Development Inc. Funding from the B.C. Habitat Conservation Fund.
Fertilizer Applied: prill (solid) form – 34-0-0 and 12-51-0 blend.
Period of Application: June 2 – August 26, 1989.
Sites: Norris Creek, Grilse Creek (upper bridge site).
Water chemistry samples: 10 sample sets from 3 sample sites.
Periphyton samples: ✔ Two series of 35 and 40 days- from 3 sites.
Taxonomy samples: Algae ✔ Three sample sites.
References: Perrin (1990).

1990 **Agencies:** MELP, NANAIMO. Contractor: Limnotek Research and Development Inc. Funding from the B.C. Habitat Conservation Fund.
Fertilizer Applied: Liquid- 32-0-0 (Norris Creek only) and 10-34-0.
Period of Application: May 12 – July 29, 1990.
Sites: Norris Creek, Grilse Creek (upper), Grilse Creek (lower bridge site).
Water chemistry samples: ✔ Seven sample sets from 5 sites.
Periphyton samples : ✔ One series (7 samples over 51 days) from 4 sites.
Taxonomy samples: ✔ One set from 4 sites; one replicate from 2 sites.
References: Perrin (1991b).

1991 **Agencies:** MELP, NANAIMO. Contractor: Limnotek Research and Development Inc. Funding from the B.C. Habitat Conservation Fund.
Fertilizer Applied: Liquid- 32-0-0 (Norris Creek only) and 10-34-0.
Period of Application: May 18 – July 31, 1991.
Sites: Norris Creek, Grilse Creek (upper) and Grilse Creek (lower bridge site).

Water chemistry samples: ✔ Four sample sets from six sites.
Periphyton samples: ✔ Eight sample sets from five sites (one series over 57 days).
Taxonomy samples: Algae ✔ One sample set from 5 sites.
References: Perrin (1991a).

1992 **Agencies:** MELP, NANAIMO. (Administered by B.C. Conservation Foundation (BCCF). Funding from the Habitat Conservation Fund).
Fertilizer Applied: Liquid- 32-0-0 (Norris Creek only) and 10-34-0.
Period of Application: May 15 – July 28, 1992.
Sites: Norris Creek, Grilse Creek (upper bridge), Grilse Creek (lower bridge).
Water chemistry samples: ✔ Three sample sets from six sites.
Periphyton samples: No.
Taxonomy samples: No.
References: Carswell (1992).

1993 **Agencies:** MELP, NANAIMO. (Admin. by BCCF. Funding from the B.C. Habitat Conservation Fund and fertilizer purchased by the Campbell River Chapter of the Steelhead Society of B.C.).
Fertilizer Applied: Liquid- 32-0-0 (Norris Ck. only) and 10-34-0.
Period of Application: May 25 – August 8, 1993.
Sites: Norris Creek, Grilse Creek (upper bridge), Salmon River- Rock Creek ML bridge crossing, Memekay ML bridge crossing.
Water chemistry samples: ✔
Periphyton samples: ✔
Taxonomy samples: unknown (see Comments).
References: Carswell (1993).

Comments: Water, periphyton and insect sampling were conducted by Daiva Zaldokas, MELP, Vancouver, Fisheries Research and Development Section.

1994 **Agencies:** MELP, NANAIMO. (Admin. by BCCF. Funding from the B.C. Habitat Conservation Fund, liquid fertilizer purchased by the Campbell R. Chapter of the Steelhead Society of B.C.).

Fertilizer Applied: Liquid- 32-0-0 (Norris Creek only) and 10-34-0.
Period of Application: May 19 – August 14, 1994.
Sites: Norris Creek, Grilse Creek (upper bridge), Salmon River- Rock Creek ML bridge crossing, Memekay ML bridge crossing.
Water chemistry samples: Two sample sets from ten sites.
Periphyton samples: No.
Taxonomy samples: No.
References: Hansen (1994).

1995 **Agencies:** MELP, NANAIMO. (Admin. by BCCF. Funding from Habitat Conservation Fund, liquid fertilizer purchased by the Campbell R. Chapter of the Steelhead Society of B.C.).
MELP, Vancouver, Fisheries Research and Development Section monitored slow-release briquettes (pucks) in Norris Creek and Grilse Creek.

Fertilizer Applied: Briquettes in Norris Creek and Grilse Creek and liquid 10-34-0 in the mainstem Salmon River.
Period of Application: May 25 – August 25, 1995.
Sites: Norris Creek, Grilse Creek (upper bridge), Salmon River- Rock Creek ML bridge crossing, Memekay ML bridge crossing.
Water chemistry samples: ✔ Two sample sets from five sites on the mainstem Salmon River. Seven sample sets from five sample sites on Norris Creek and Grilse Creek (MELP, Vancouver).
Periphyton samples: ✔ (MELP, Vancouver).
Taxonomy samples: ✔ (MELP, Vancouver).
References: Hansen (1995). Mouldey Ewing, Ashley (1998).

Comments: An in-depth study of the slow-release fertilizer was conducted by the MELP Fisheries Research and Development Section, Vancouver, from 1995 to 1997 inclusive. Three reports are cited in **REFERENCES** (Mouldey Ewing, et al. 1996, 1998, 1998).

1996 **Agencies:** MELP, NANAIMO. (Admin. by BCCF. Funding from the B.C. Habitat Conservation Fund, liquid fertilizer paid for by the Campbell River Chapter of the Steelhead Society of B.C.) .
MELP, Vancouver, Fisheries Research and Development Section, monitored slow-release briquettes in Norris Creek and Grilse Creek.
Fertilizer Applied: Briquettes- Norris Creek and Grilse Creek. Liquid 10-34-0- Salmon River mainstem.
Period of Application: June 1 – September 5.
Sites: Briquettes- Norris Creek, Grilse Creek (upper bridge). Liquid- (Salmon River)- Rock Creek ML bridge crossing, fish screen, and Memekay ML bridge crossing.
Water chemistry samples: ✔ Two sample sets from six sites on the mainstem Salmon River. Nine sample sets of five sites on Norris Creek (2 sites) and Grilse Creek (3 sites).
Periphyton samples: ✔ Nine sample sets from five sites on Norris Creek (2 sites) and Grilse Creek (3 sites).
Taxonomy samples: algae.
Benthic invertebrate biomass measured: ✔
References: Hansen (1999b). Mouldey Ewing and Ashley (1998).

Comments: Fertilizer toxicology testing was conducted by EVS Environmental Consultants (1997) for rainbow trout, chironomids, amphipods and daphnids.

1997 **Agencies:** MELP, NANAIMO. (Admin. by BCCF. Funding by BC Hydro and the Campbell River Chapter of the Steelhead Society of B.C.).
MELP, Vancouver. Fisheries Research and Development Section.
Fertilizer Applied: Briquettes (7-40-0) (Norris Creek and Grilse Creek) and 10-34-0 (mainstem Salmon River).
Period of Application: June 12 – October 6.
Sites: Norris Creek (briquettes), Grilse Creek (upper bridge) (briquettes), Salmon River- Rock Creek ML bridge crossing (liquid), fish screen (liquid), and Memekay ML bridge crossing (liquid).
Water chemistry samples: ✔ Every two weeks (eight sample sets) from nine sample sites throughout 40 km of the river treatment area.

Periphyton samples: ✔ Eight sample sets from nine sample sites.
Taxonomy samples: algae. ✔
Benthic invertebrate biomass measured: ✔
References: Hansen (1999a). Mouldey, Ashley & Wilson (1998).

Comments: In addition to treatment of the upper Salmon River and tributaries, the Memekay River and Cooper Creek were treated with briquettes (7-40-0): 60 kg to Cooper Creek and 599 kg to each of two sites on the Memekay River (total – 1,198 kg). **Water chemistry samples:** ✔ Two sample sets. **Periphyton:** none. **Taxonomy:** none.

1998 **Agencies:** MELP, NANAIMO. (Admin. by BCCF. Funding - BC Hydro).
Fertilizer Applied: Briquettes - 7-40-0 (Norris Creek) and liquid 10-34-0.
Period of Application: June 10 – August 19.
Sites: Norris Creek, Grilse Creek (upper bridge), Salmon River- above Rock Creek ML bridge crossing, fish screen and Memekay ML bridge crossing.
Water chemistry samples: No.
Periphyton samples: No.
Taxonomy samples: No.
References: Hansen (1999c).

Comments: In addition to the mainstem Salmon River and upper Salmon tributaries, the Memekay River and Cooper Creek were also treated. Sixty kilograms of briquettes were added to the upper end of Cooper Creek and liquid 10-34-0 was applied by drip station to the Memekay River just below the ML bridge.

1999 **Agencies:** MELP, NANAIMO. (Admin. by BCCF. Funding BC Hydro).
Fertilizer Applied: 10-34-0.
Period of Application: August 9 – September 28.
Sites: Grilse Creek (upper bridge), Salmon River- above Rock Creek ML bridge crossing, fish screen and Memekay ML bridge crossing.
Water chemistry samples: No.
Periphyton samples: No.
Taxonomy samples: No.
References: Hansen (1999d).

Comments: In addition, a liquid drip station (10-34-0) was maintained on the Memekay River just below the Memekay ML bridge. Due to extremely high flows from a record high snow-pack, discharge in the Salmon River and tributaries was too high in June and July for practical delivery of a fertilizer drip-rate. Fertilization did not start until early August when flows had moderated, and was continued later than in previous years.

2000 **Agencies:** MELP, NANAIMO. (Admin. by BCCF. Funding BC Hydro)
Fertilizer Applied: 10-34-0 and briquettes (new formula).
Period of Application: June 19 – September 12.
Sites: Briquettes- Grilse Creek just upstream of the falls, Liquid- Grilse Creek (upper bridge), Salmon River- above Rock Creek ML bridge crossing, fish screen and Memekay ML bridge crossing.
Water chemistry samples: No.
Periphyton samples: No.
Taxonomy samples: No.
References: Hansen (2001).

Comments: Briquettes were placed in Cooper Creek, 7 km upstream of the confluence with the Memekay River. A liquid drip station (10-34-0) was maintained on the Memekay River just below the Memekay ML bridge.

2001 **Agencies:** MWLAP, NANAIMO. (Admin. by BCCF. Funding by Weyerhaeuser (FRBC) & BC Hydro, Bridge Coastal Restoration Program).
Fertilizer Applied: 10-34-0.
Period of Application: July 5 – August 24.
Sites: Memekay River at the ML bridge crossing, Grilse Creek (upper bridge), Salmon River- upstream of Rock Creek ML bridge crossing (deactivated), fish screen and Memekay ML bridge crossing.
Water chemistry samples: Yes.
Periphyton samples: Yes.
Taxonomy samples: No.
References: Hansen, (2002).

2002 **Agencies:** MWLAP, NANAIMO. (Admin. by BCCF. Funding by BC Hydro, Bridge Coastal Restoration Program).
Fertilizer Applied: 10-34-0.
Period of Application: June 18 – August 19.
Sites: Memekay River at the ML bridge crossing, Grilse Creek (upper bridge), Salmon River upstream of Rock Creek ML bridge crossing (deactivated), fish screen and Memekay ML bridge crossing.
Water chemistry samples: Yes.
Periphyton samples: Yes.
Taxonomy samples: No.
References: Hansen, (2003)

Comments: An experimental, slow-release fertilizer product was applied to the upper Salmon River just below the Jessie Creek confluence on July 29, 2002. The fertilizer was a struvite-coated urea granule (18-6-0) produced by PSP Enterprises of Urbana, Ohio. **Water chemistry samples:** Yes. **Periphyton samples:** Yes.

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APPENDIX 2.

Calibrated drip-rate of liquid 10-34-0, given in ml/min, based on streamflow (L/s) to achieve a target addition of 5 µg/L of soluble reactive phosphorus (SRP).

Salmon River (Vancouver Island) fertilizer calculations - K. Ashley, May 21/93)

Tank 3 - Salmon River

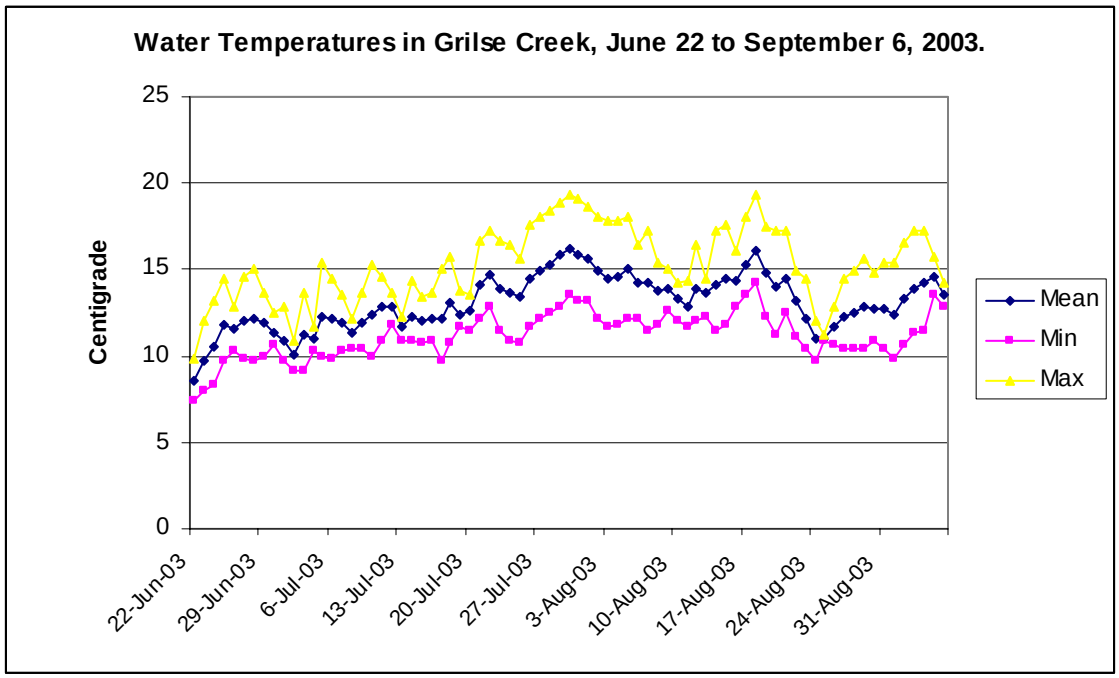
Fertilizer is 10-34-0 (liquid ammonium polyphosphate)
Specifications: 10% N by weight; 34% P2O5 by weight, 14.85% P by weight
Density: 1.4, weight is 1.4 kg/L

Applied SRP (ug/L)	Flow L/s	weight/min grams P	weight/min gr 10-34-0	mL/min 10-34-0	L/day 10-34-0	Weight/day kg P	Weight/day kg N
5	100	0.03	0.20	0.14	0.21	0.04	0.03
5	200	0.06	0.40	0.29	0.42	0.09	0.06
5	300	0.09	0.61	0.43	0.62	0.13	0.09
5	400	0.12	0.81	0.58	0.83	0.17	0.12
5	500	0.15	1.01	0.72	1.04	0.22	0.15
5	600	0.18	1.21	0.87	1.25	0.26	0.17
5	700	0.21	1.41	1.01	1.45	0.30	0.20
5	800	0.24	1.62	1.15	1.66	0.35	0.23
5	900	0.27	1.82	1.30	1.87	0.39	0.26
5	1000	0.30	2.02	1.44	2.08	0.43	0.29
5	1100	0.33	2.22	1.59	2.29	0.48	0.32
5	1200	0.36	2.42	1.73	2.49	0.52	0.35
5	1300	0.39	2.63	1.88	2.70	0.56	0.38
5	1400	0.42	2.83	2.02	2.91	0.60	0.41
5	1500	0.45	3.03	2.16	3.12	0.65	0.44
5	1600	0.48	3.23	2.31	3.32	0.69	0.47
5	1700	0.51	3.43	2.45	3.53	0.73	0.49
5	1800	0.54	3.64	2.60	3.74	0.78	0.52
5	1900	0.57	3.84	2.74	3.95	0.82	0.55
5	2000	0.60	4.04	2.89	4.16	0.86	0.58
5	2100	0.63	4.24	3.03	4.36	0.91	0.61
5	2200	0.66	4.44	3.17	4.57	0.95	0.64
5	2300	0.69	4.65	3.32	4.78	0.99	0.67
5	2400	0.72	4.85	3.46	4.99	1.04	0.70
5	2500	0.75	5.05	3.61	5.19	1.08	0.73
5	2600	0.78	5.25	3.75	5.40	1.12	0.76
5	2700	0.81	5.45	3.90	5.61	1.17	0.79
5	2800	0.84	5.66	4.04	5.82	1.21	0.81
5	2900	0.87	5.86	4.18	6.03	1.25	0.84
5	3000	0.90	6.06	4.33	6.23	1.30	0.87
5	3100	0.93	6.26	4.47	6.44	1.34	0.90
5	3200	0.96	6.46	4.62	6.65	1.38	0.93
5	3300	0.99	6.67	4.76	6.86	1.43	0.96
5	3400	1.02	6.87	4.91	7.06	1.47	0.99
5	3500	1.05	7.07	5.05	7.27	1.51	1.02
5	3600	1.08	7.27	5.19	7.48	1.56	1.05
5	3700	1.11	7.47	5.34	7.69	1.60	1.08

APPENDIX 3.

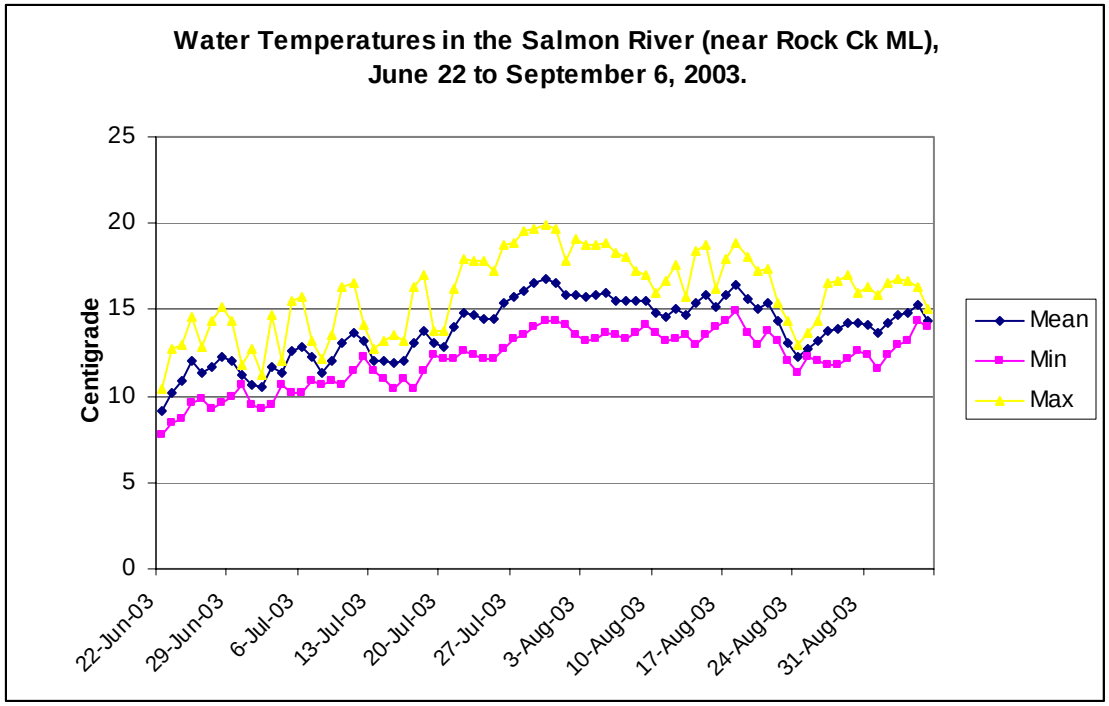
Daily mean, minimum and maximum temperatures (°C) for Grilse Creek, Memekay River and the Salmon River from June to September, 2003, using StowAway® Tidbit® Loggers (Onset Computer Corp.).

GRILSE CREEK – 2003. Water Temperatures (°C).							
Date (2003)	**Mean**	**Min**	**Max**	**Date (2003)**	**Mean**	**Min**	**Max**
Jun 22	8.6	7.4	9.8	Aug 1	15.6	13.2	18.6
Jun 23	9.7	8.0	12.0	Aug 2	14.9	12.2	18.1
Jun 24	10.5	8.3	13.2	Aug 3	14.5	11.7	17.8
Jun 25	11.8	9.7	14.5	Aug 4	14.6	11.8	17.8
Jun 26	11.6	10.3	12.9	Aug 5	15.0	12.2	18.1
Jun 27	12.0	9.8	14.6	Aug 6	14.2	12.2	16.4
Jun 28	12.2	9.7	15.1	Aug 7	14.2	11.5	17.3
Jun 29	11.9	10.0	13.7	Aug 8	13.8	11.8	15.4
Jun 30	11.3	10.6	12.5	Aug 9	13.9	12.6	15.1
Jul 1	10.9	9.7	12.8	Aug 10	13.3	12.0	14.2
Jul 2	10.1	9.1	10.9	Aug 11	12.9	11.7	14.3
Jul 3	11.2	9.2	13.7	Aug 12	13.9	12.0	16.4
Jul 4	11.0	10.3	11.7	Aug 13	13.6	12.3	14.5
Jul 5	12.3	10.0	15.4	Aug 14	14.1	11.5	17.2
Jul 6	12.2	9.8	14.5	Aug 15	14.5	11.8	17.6
Jul 7	11.9	10.3	13.5	Aug 16	14.4	12.9	16.1
Jul 8	11.4	10.4	12.2	Aug 17	15.3	13.5	18.0
Jul 9	11.9	10.4	13.7	Aug 18	16.1	14.2	19.3
Jul 10	12.4	10.0	15.3	Aug 19	14.8	12.3	17.5
Jul 11	12.9	10.9	14.6	Aug 20	14.0	11.2	17.2
Jul 12	12.8	11.8	13.7	Aug 21	14.5	12.5	17.2
Jul 13	11.7	10.9	12.3	Aug 22	13.2	11.1	14.9
Jul 14	12.3	10.9	14.3	Aug 23	12.2	10.4	14.5
Jul 15	12.0	10.8	13.4	Aug 24	11.0	9.7	12.0
Jul 16	12.1	10.9	13.7	Aug 25	11.0	10.9	11.2
Jul 17	12.2	9.7	15.1	Aug 26	11.7	10.6	12.8
Jul 18	13.1	10.8	15.7	Aug 27	12.3	10.4	14.5
Jul 19	12.4	11.7	13.8	Aug 28	12.5	10.4	14.9
Jul 20	12.6	11.5	13.5	Aug 29	12.9	10.4	15.6
Jul 21	14.1	12.2	16.7	Aug 30	12.7	10.9	14.8
Jul 22	14.7	12.9	17.2	Aug 31	12.7	10.4	15.4
Jul 23	13.9	11.5	16.7	Sept 1	12.4	9.8	15.4
Jul 24	13.6	10.9	16.4	Sept 2	13.3	10.6	16.5
Jul 25	13.4	10.8	15.6	Sept 3	13.9	11.4	17.2
Jul 26	14.5	11.7	17.6	Sept 4	14.2	11.5	17.2
Jul 27	14.9	12.2	18.0	Sept 5	14.6	13.5	15.7
Jul 28	15.3	12.5	18.4	Sept 6	13.5	12.9	14.2
Jul 29	15.8	12.9	18.9				
Jul 30	16.2	13.5	19.3				
Jul 31	15.9	13.2	19.1				
Jul avg.	**13.0**	**9.1**	**19.3**	**Aug avg.**	**13.7**	**9.7**	**19.3**


Water Temperatures in Grilse Creek, June 22 to September 6, 2003.
Centigrade
25
20
15
10
5
0
22-Jun-03
29-Jun-03
6-Jul-03
13-Jul-03
20-Jul-03
27-Jul-03
3-Aug-03
10-Aug-03
17-Aug-03
24-Aug-03
31-Aug-03
Mean
Min
Max

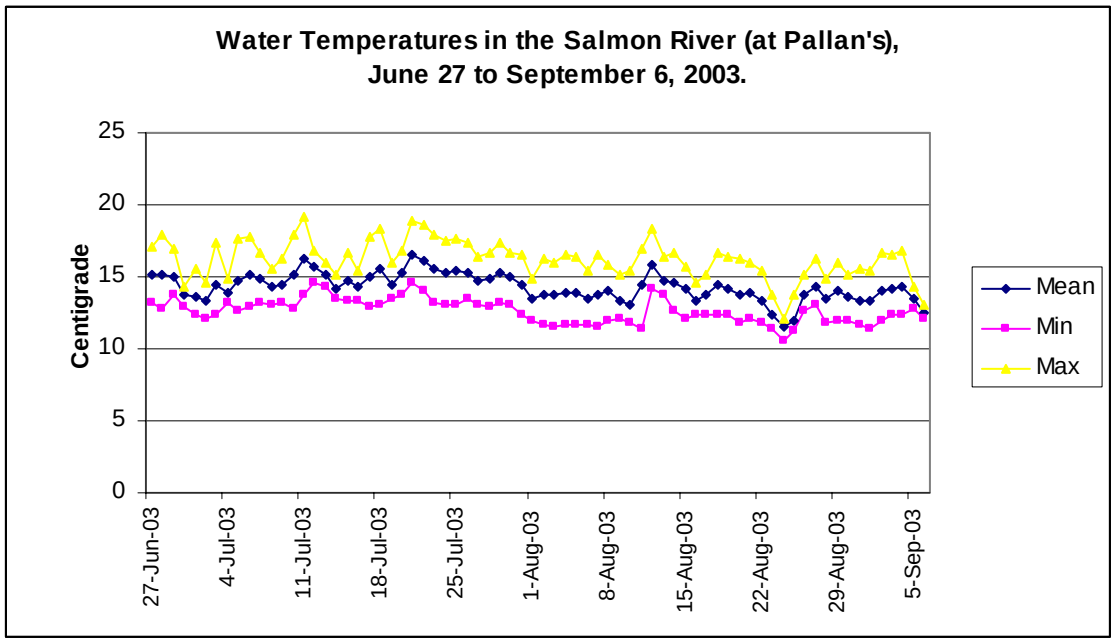
APPENDIX 3 (cont'd)

Salmon River above Rock Ck ML (tank site) 2003. Water Temperatures (°C).							
Date (2003)	**Mean**	**Min**	**Max**	**Date (2003)**	**Mean**	**Min**	**Max**
Jun 22	9.1	7.8	10.4	Aug 1	15.9	14.1	17.8
Jun 23	10.2	8.4	12.7	Aug 2	15.9	13.5	19.1
Jun 24	10.9	8.7	13.0	Aug 3	15.7	13.2	18.7
Jun 25	12.0	9.6	14.6	Aug 4	15.8	13.3	18.7
Jun 26	11.4	9.8	12.9	Aug 5	16.0	13.7	18.9
Jun 27	11.7	9.3	14.3	Aug 6	15.5	13.5	18.3
Jun 28	12.3	9.6	15.2	Aug 7	15.5	13.3	18.1
Jun 29	12.0	9.9	14.4	Aug 8	15.5	13.7	17.3
Jun 30	11.2	10.6	11.8	Aug 9	15.5	14.1	17.0
Jul 1	10.7	9.5	12.7	Aug 10	14.8	13.7	16.0
Jul 2	10.5	9.3	11.2	Aug 11	14.6	13.2	16.7
Jul 3	11.7	9.5	14.7	Aug 12	15.0	13.3	17.6
Jul 4	11.4	10.7	12.0	Aug 13	14.7	13.5	15.7
Jul 5	12.6	10.2	15.5	Aug 14	15.4	13.0	18.4
Jul 6	12.9	10.2	15.7	Aug 15	15.8	13.5	18.7
Jul 7	12.3	10.9	13.2	Aug 16	15.2	14.0	16.2
Jul 8	11.4	10.7	12.1	Aug 17	15.8	14.3	17.9
Jul 9	12.0	10.9	13.5	Aug 18	16.4	14.9	18.9
Jul 10	13.1	10.7	16.3	Aug 19	15.6	13.7	18.1
Jul 11	13.7	11.5	16.5	Aug 20	15.1	13.0	17.3
Jul 12	13.2	12.3	14.1	Aug 21	15.4	13.8	17.4
Jul 13	12.0	11.5	12.7	Aug 22	14.3	13.2	15.4
Jul 14	12.0	11.0	13.2	Aug 23	13.1	12.0	14.3
Jul 15	11.9	10.4	13.5	Aug 24	12.3	11.3	13.0
Jul 16	12.0	11.0	13.2	Aug 25	12.7	12.3	13.7
Jul 17	13.1	10.4	16.3	Aug 26	13.2	12.0	14.3
Jul 18	13.8	11.5	17.0	Aug 27	13.8	11.8	16.5
Jul 19	13.1	12.4	13.8	Aug 28	13.9	11.8	16.7
Jul 20	12.9	12.1	13.8	Aug 29	14.2	12.1	17.0
Jul 21	14.0	12.1	16.2	Aug 30	14.2	12.6	16.0
Jul 22	14.8	12.6	17.9	Aug 31	14.1	12.4	16.3
Jul 23	14.7	12.4	17.8	Sept 1	13.6	11.6	15.9
Jul 24	14.5	12.1	17.8	Sept 2	14.2	12.4	16.5
Jul 25	14.5	12.1	17.3	Sept 3	14.7	13.0	16.8
Jul 26	15.4	12.7	18.7	Sept 4	14.8	13.2	16.7
Jul 27	15.7	13.3	18.9	Sept 5	15.3	14.4	16.3
Jul 28	16.1	13.5	19.6	Sept 6	14.4	14.0	15.1
Jul 29	16.5	14.0	19.7				
Jul 30	16.8	14.4	19.9				
Jul 31	16.6	14.3	19.7				
Jul avg.	**13.4**	**9.3**	**19.9**	**Aug avg.**	**14.9**	**11.3**	**19.1**


Water Temperatures in the Salmon River (near Rock Ck ML),
June 22 to September 6, 2003.
Centigrade
25
20
15
10
5
0
22-Jun-03
29-Jun-03
6-Jul-03
13-Jul-03
20-Jul-03
27-Jul-03
3-Aug-03
10-Aug-03
17-Aug-03
24-Aug-03
31-Aug-03
Mean
Min
Max

APPENDIX 3 (cont'd)

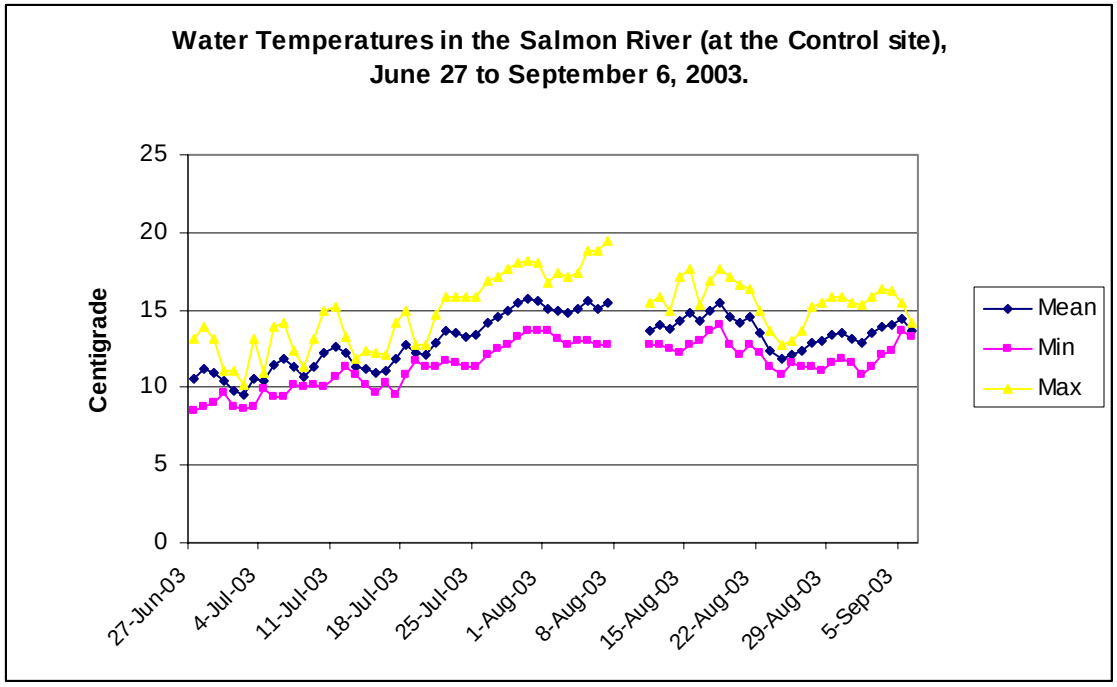
Salmon River at Pallan's – 2003. Water Temperatures (°C).							
Date (2003)	**Mean**	**Min**	**Max**	**Date (2003)**	**Mean**	**Min**	**Max**
Jun 27	15.1	13.2	17.1	Aug 1	13.5	12.0	14.9
Jun 28	15.1	12.8	17.9	Aug 2	13.8	11.7	16.2
Jun 29	15.0	13.7	17.0	Aug 3	13.7	11.5	16.0
Jun 30	13.7	12.9	14.3	Aug 4	13.9	11.7	16.5
Jul 1	13.6	12.3	15.6	Aug 5	13.9	11.7	16.4
Jul 2	13.4	12.1	14.6	Aug 6	13.5	11.7	15.4
Jul 3	14.4	12.3	17.3	Aug 7	13.8	11.5	16.5
Jul 4	13.9	13.2	14.8	Aug 8	14.0	12.0	15.9
Jul 5	14.7	12.6	17.6	Aug 9	13.3	12.1	15.2
Jul 6	15.1	12.9	17.8	Aug 10	13.1	11.8	15.4
Jul 7	14.9	13.2	16.7	Aug 11	14.4	11.4	17.0
Jul 8	14.3	13.1	15.6	Aug 12	15.9	14.1	18.3
Jul 9	14.5	13.2	16.2	Aug 13	14.7	13.7	16.4
Jul 10	15.2	12.8	17.9	Aug 14	14.6	12.6	16.7
Jul 11	16.2	13.7	19.2	Aug 15	14.1	12.1	15.7
Jul 12	15.7	14.6	16.8	Aug 16	13.4	12.3	14.6
Jul 13	15.1	14.3	16.0	Aug 17	13.7	12.4	15.2
Jul 14	14.2	13.5	15.1	Aug 18	14.4	12.4	16.7
Jul 15	14.7	13.4	16.7	Aug 19	14.1	12.3	16.4
Jul 16	14.3	13.4	15.4	Aug 20	13.8	11.8	16.2
Jul 17	15.0	12.9	17.8	Aug 21	13.9	12.1	16.0
Jul 18	15.6	13.1	18.4	Aug 22	13.4	11.8	15.4
Jul 19	14.5	13.5	16.0	Aug 23	12.4	11.4	13.8
Jul 20	15.3	13.8	16.8	Aug 24	11.5	10.6	12.1
Jul 21	16.5	14.6	18.9	Aug 25	12.0	11.2	13.7
Jul 22	16.1	14.0	18.6	Aug 26	13.7	12.6	15.1
Jul 23	15.5	13.2	17.9	Aug 27	14.3	13.1	16.2
Jul 24	15.3	13.1	17.5	Aug 28	13.5	11.8	14.9
Jul 25	15.4	13.1	17.6	Aug 29	14.0	12.0	16.0
Jul 26	15.3	13.5	17.3	Aug 30	13.6	12.0	15.2
Jul 27	14.7	13.1	16.4	Aug 31	13.4	11.7	15.6
Jul 28	14.8	12.9	16.7	Sept 1	13.3	11.4	15.4
Jul 29	15.3	13.2	17.3	Sept 2	14.0	12.0	16.7
Jul 30	15.0	13.1	16.7	Sept 3	14.2	12.4	16.5
Jul 31	14.4	12.3	16.5	Sept 4	14.3	12.4	16.8
				Sept 5	13.5	12.8	14.3
				Sept 6	12.5	12.1	13.1
Jul avg.	**14.9**	**12.1**	**19.2**	**Aug avg.**	**13.7**	**10.6**	**18.3**


Water Temperatures in the Salmon River (at Pallan's),
June 27 to September 6, 2003.
Centigrade
25
20
15
10
5
0
27-Jun-03
4-Jul-03
11-Jul-03
18-Jul-03
25-Jul-03
1-Aug-03
8-Aug-03
15-Aug-03
22-Aug-03
29-Aug-03
5-Sep-03
Mean
Min
Max

APPENDIX 3 (cont'd)

Salmon River Control (old bridge washout (SF-A spur) – 2003. Water Temperatures (°C).							
Date (2003)	**Mean**	**Min**	**Max**	**Date (2003)**	**Mean**	**Min**	**Max**
Jun 27	10.6	8.5	13.1	Aug 1	15.1	13.7	16.7
Jun 28	11.2	8.8	13.9	Aug 2	15.0	13.1	17.4
Jun 29	10.9	9.0	13.1	Aug 3	14.8	12.8	17.2
Jun 30	10.4	9.7	11.1	Aug 4	15.1	13.0	17.4
Jul 1	9.8	8.8	11.1	Aug 5	15.6	13.0	18.8
Jul 2	9.5	8.6	10.2	Aug 6	15.1	12.8	18.8
Jul 3	10.6	8.8	13.1	Aug 7	15.4	12.8	19.5
Jul 4	10.5	9.9	11.0	Aug 8*			
Jul 5	11.5	9.4	13.9	Aug 9*			
Jul 6	11.8	9.4	14.2	Aug 10*			
Jul 7	11.4	10.2	12.4	Aug 11	13.7	12.8	15.5
Jul 8	10.7	10.0	11.3	Aug 12	14.1	12.8	15.9
Jul 9	11.3	10.2	13.1	Aug 13	13.8	12.5	15.0
Jul 10	12.2	10.0	15.0	Aug 14	14.3	12.2	17.1
Jul 11	12.6	10.7	15.2	Aug 15	14.8	12.7	17.6
Jul 12	12.3	11.4	13.3	Aug 16	14.3	13.0	15.3
Jul 13	11.3	10.8	11.9	Aug 17	15.0	13.6	16.9
Jul 14	11.2	10.2	12.4	Aug 18	15.5	14.1	17.7
Jul 15	10.9	9.7	12.2	Aug 19	14.6	12.8	17.1
Jul 16	11.1	10.3	12.1	Aug 20	14.2	12.1	16.6
Jul 17	11.8	9.6	14.2	Aug 21	14.5	12.8	16.4
Jul 18	12.7	10.8	15.0	Aug 22	13.5	12.2	15.0
Jul 19	12.3	11.7	12.8	Aug 23	12.4	11.3	13.6
Jul 20	12.1	11.4	12.8	Aug 24	11.9	10.8	12.8
Jul 21	12.9	11.3	14.7	Aug 25	12.1	11.6	13.0
Jul 22	13.7	11.7	15.9	Aug 26	12.4	11.4	13.6
Jul 23	13.5	11.6	15.8	Aug 27	12.9	11.3	15.2
Jul 24	13.3	11.3	15.8	Aug 28	13.0	11.1	15.5
Jul 25	13.4	11.4	15.8	Aug 29	13.4	11.6	15.9
Jul 26	14.2	12.1	16.9	Aug 30	13.5	11.9	15.8
Jul 27	14.6	12.5	17.2	Aug 31	13.2	11.6	15.5
Jul 28	14.9	12.8	17.7	Sept 1	12.9	10.8	15.3
Jul 29	15.4	13.3	18.0	Sept 2	13.5	11.4	15.9
Jul 30	15.7	13.7	18.2	Sept 3	13.9	12.1	16.4
Jul 31	15.6	13.7	18.0	Sept 4	14.1	12.4	16.3
				Sept 5	14.4	13.6	15.5
				Sept 6	13.7	13.3	14.2
Jul avg.	**12.4**	**8.6**	**18.2**	**Aug avg.**	**14.0**	**10.8**	**19.5**

*Datalogger was partially out of the water.



Memekay River (tank site) – 2003. Water Temperatures (°C).							
Date (2003)	**Mean**	**Min**	**Max**	**Date (2003)**	**Mean**	**Min**	**Max**
Jun 22	8.6	7.0	10.6	Jun 27	11.0	8.7	14.3
Jun 23	9.3	7.2	12.0	Jun 28	11.5	8.7	14.9
Jun 24	10.1	7.9	12.6	Jun 29	11.4	9.3	13.4
Jun 25	11.0	8.7	14.1	Jun 30	10.6	10.1	11.8
*Jun 26	10.8	8.9	13.8	Jul 1	10.5	9.3	11.6

*Data limited, due to incorrect datalogger settings.

APPENDIX 4.

Spot temperatures (and time) recorded at the LIQUID FERTILIZATION sample sites in Grilse Creek, the Salmon River and the Memekay River in 2003. A hand-held alcohol thermometer was used.

Date	Grilse Creek		Salmon River					Memekay River	
2003	Tank	Treatment	Control	Screen	MML	WSC	Pallan's	Control	Treatment
Jun 17	11° 1:55			12° 15:00	12° 16:20			11.5° 17:05	
Jun 21	9° 14:30			9 15:35	12° 13:15			9° 12:15	
Jun 23	10.5° 12:00			10.5° 12:50	13.5° 16:00			11.5° 16:20	
Jun 26	12° 13:30		11° 14:00	13.5° 14:45	14.5° 15:10				
Jun30	11° 11:30			11°	12.5° 13:00			10.5° 13:35	
Jul 2	11.5° 14:05			11.5° 14:43	13.5° 15:05			11° 15:30	
Jul 5	13° 11:35			12° 12:45	15.5° 13:15			13:45° 13.5	
Jul 8	11.5° 12:15			12° 13:05	13° 14:05			12° 14:40	
Jul 11	14.5° 12:50			15° 14:00	16° 11:50			12.5° 11:20	
Jul 15	12.5° 14:45	14° 15:20	11° 15:35			16° 16:45	16° 17:15	13° 16:15	
Jul 16					14° 14:20				
Jul 17	15° 14:00			14° 14:45				15.5° 16:40	
Jul 22	15° 13:00			15.5° 13:30	16.5° 11:45			14° 11:00	
Jul 25	15.5° 14:35			16° 15:05	18.5° 13:45			15° 13:20	
Jul 28	15° 14:45			18° 15:20	20° 14:30			17° 13:30	
Aug 1	16.5° 12:45			17° 13:25	19° 13:55			17.5° 14:30	
Aug 5	15.5° 13:00			16.5° 12:00	19° 14:00			15.5° 13:30	
Aug 8	16° 13:15			17° 14:00	18.5° 12:20				
Aug 11				16.5° 13:00	18° 11:00			15° 11:30	
Aug 12	13.5° 13:25	17° 14:15	15° 14:30			16.5° 11:57	15° 11:15	14° 12:25	14.5° 11:40
Aug 15	15° 12:10			16.5° 12:50	17° 11:15			14.5° 11:40	
Aug 18	16° 12:13			18° 13:13	18° 10:57			15.5° 11:25	
Aug 21	18° 14:00			18° 15:00	17.5° 12:30			15° 13:00	
Aug 25	11° 13:50			13° 14:23	14° 12:15			12° 12:45	
Aug 29				16° 15:05	17° 12:25			13°	
Sept 5					17.5° 11:40				
Sept 7	11.5° 11:20	14.5° 11:55	13° 12:15			15.5° 13:20	14.5° 13:45	14° 12:50	

APPENDIX 5.

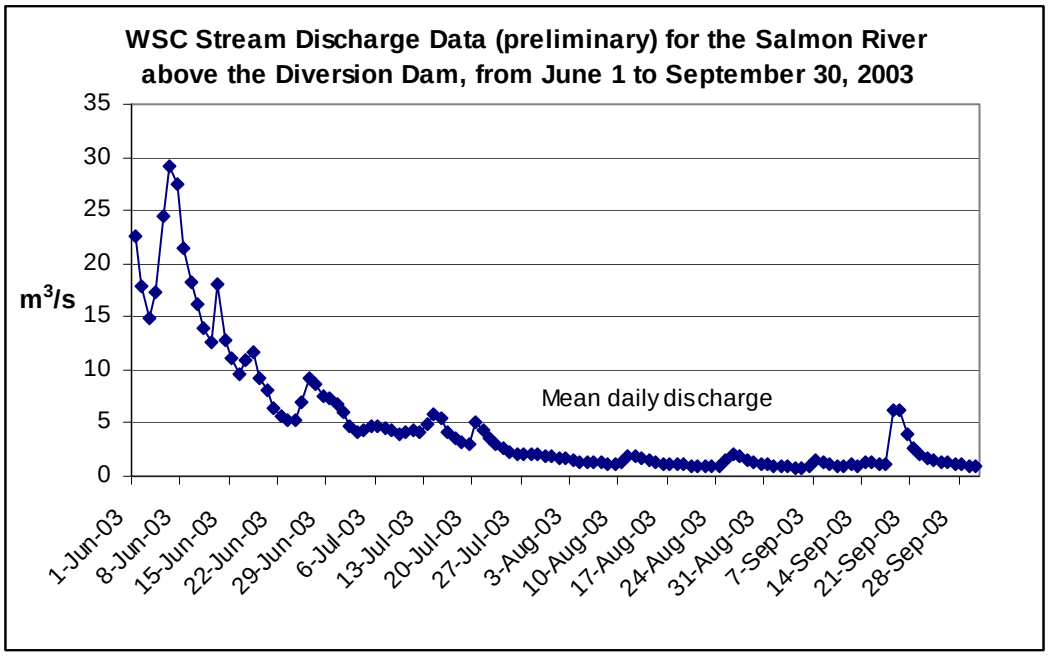
Water Survey of Canada, discharge data (preliminary) for the Salmon River from June 1 to September 30, 2003.

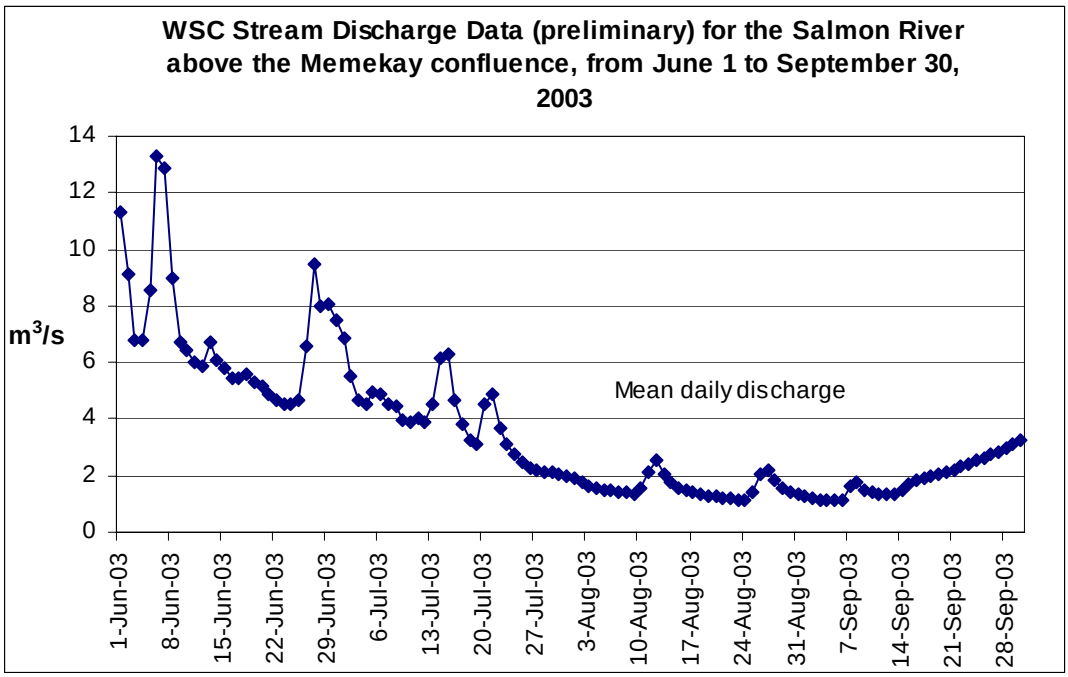
Salmon River - Above the diversion dam (#08HD015)							
Date	Mean (m^3/s)	Date	Mean (m^3/s)	Date	Mean (m^3/s)	Date	Mean (m^3/s)
1-Jun-03	22.5	1-Jul-03	5.95	1-Aug-03	1.75	1-Sep-03	0.971
2-Jun-03	17.8	2-Jul-03	4.77	2-Aug-03	1.63	2-Sep-03	0.913
3-Jun-03	14.9	3-Jul-03	4.08	3-Aug-03	1.5	3-Sep-03	0.868
4-Jun-03	17.3	4-Jul-03	4.27	4-Aug-03	1.4	4-Sep-03	0.844
5-Jun-03	24.4	5-Jul-03	4.67	5-Aug-03	1.35	5-Sep-03	0.799
6-Jun-03	29.2	6-Jul-03	4.73	6-Aug-03	1.3	6-Sep-03	0.849
7-Jun-03	27.5	7-Jul-03	4.53	7-Aug-03	1.26	7-Sep-03	1.48
8-Jun-03	21.5	8-Jul-03	4.4	8-Aug-03	1.21	8-Sep-03	1.35
9-Jun-03	18.3	9-Jul-03	3.95	9-Aug-03	1.19	9-Sep-03	1.13
10-Jun-03	16.2	10-Jul-03	4.15	10-Aug-03	1.3	10-Sep-03	1.03
11-Jun-03	13.9	11-Jul-03	4.3	11-Aug-03	1.85	11-Sep-03	1.02
12-Jun-03	12.7	12-Jul-03	4.15	12-Aug-03	1.9	12-Sep-03	1.05
13-Jun-03	18	13-Jul-03	4.84	13-Aug-03	1.62	13-Sep-03	0.986
14-Jun-03	12.8	14-Jul-03	5.76	14-Aug-03	1.42	14-Sep-03	1.3
15-Jun-03	11.1	15-Jul-03	5.44	15-Aug-03	1.29	15-Sep-03	1.33
16-Jun-03	9.61	16-Jul-03	4.13	16-Aug-03	1.19	16-Sep-03	1.19
17-Jun-03	11	17-Jul-03	3.62	17-Aug-03	1.17	17-Sep-03	1.09
18-Jun-03	11.6	18-Jul-03	3.11	18-Aug-03	1.12	18-Sep-03	6.19
19-Jun-03	9.27	19-Jul-03	3.05	19-Aug-03	1.08	19-Sep-03	6.3
20-Jun-03	8.02	20-Jul-03	5.01	20-Aug-03	1.02	20-Sep-03	3.87
21-Jun-03	6.48	21-Jul-03	4.41	21-Aug-03	0.963	21-Sep-03	2.63
22-Jun-03	5.6	22-Jul-03	3.62	22-Aug-03	0.921	22-Sep-03	2.01
23-Jun-03	5.29	23-Jul-03	3.04	23-Aug-03	0.891	23-Sep-03	1.72
24-Jun-03	5.34	24-Jul-03	2.62	24-Aug-03	0.901	24-Sep-03	1.54
25-Jun-03	7.03	25-Jul-03	2.34	25-Aug-03	1.42	25-Sep-03	1.39
26-Jun-03	9.14	26-Jul-03	2.14	26-Aug-03	2.04	26-Sep-03	1.27
27-Jun-03	8.61	27-Jul-03	2.07	27-Aug-03	1.94	27-Sep-03	1.17
28-Jun-03	7.48	28-Jul-03	2.05	28-Aug-03	1.57	28-Sep-03	1.09
29-Jun-03	7.39	29-Jul-03	2.01	29-Aug-03	1.31	29-Sep-03	1.03
30-Jun-03	6.8	30-Jul-03	1.94	30-Aug-03	1.14	30-Sep-03	0.975
		31-Jul-03	1.87	31-Aug-03	1.04		
June Mean	**13.23**	**July Mean**	**3.77**	**Aug Mean**	**1.34**	**Sept Mean**	**1.65**

Note: The Salmon River diversion was closed on June 27, 2003.

APPENDIX 5 (cont'd)

Salmon River - Above the Memekay confluence (#08HD007)							
Date	Mean (m^3/s)	Date	Mean (m^3/s)	Date	Mean (m^3/s)	Date	Mean (m^3/s)
1-Jun-03	11.3	1-Jul-03	6.85	1-Aug-03	1.89	1-Sep-03	1.25
2-Jun-03	9.1	2-Jul-03	5.53	2-Aug-03	1.79	2-Sep-03	1.2
3-Jun-03	6.81	3-Jul-03	4.64	3-Aug-03	1.66	3-Sep-03	1.16
4-Jun-03	6.8	4-Jul-03	4.5	4-Aug-03	1.56	4-Sep-03	1.13
5-Jun-03	8.55	5-Jul-03	4.94	5-Aug-03	1.49	5-Sep-03	1.11
6-Jun-03	13.3	6-Jul-03	4.91	6-Aug-03	1.46	6-Sep-03	1.16
7-Jun-03	12.9	7-Jul-03	4.54	7-Aug-03	1.42	7-Sep-03	1.63
8-Jun-03	8.99	8-Jul-03	4.42	8-Aug-03	1.39	8-Sep-03	1.74
9-Jun-03	6.7	9-Jul-03	3.93	9-Aug-03	1.36	9-Sep-03	1.52
10-Jun-03	6.42	10-Jul-03	3.89	10-Aug-03	1.56	10-Sep-03	1.39
11-Jun-03	6.03	11-Jul-03	4.06	11-Aug-03	2.09	11-Sep-03	1.36
12-Jun-03	5.86	12-Jul-03	3.89	12-Aug-03	2.52	12-Sep-03	1.35
13-Jun-03	6.69	13-Jul-03	4.5	13-Aug-03	2.06	13-Sep-03	1.35
14-Jun-03	6.06	14-Jul-03	6.15	14-Aug-03	1.77	14-Sep-03	1.5
15-Jun-03	5.78	15-Jul-03	6.29	15-Aug-03	1.58	15-Sep-03	1.7
16-Jun-03	5.43	16-Jul-03	4.64	16-Aug-03	1.46	16-Sep-03	1.81
17-Jun-03	5.46	17-Jul-03	3.85	17-Aug-03	1.41	17-Sep-03	1.89
18-Jun-03	5.62	18-Jul-03	3.26	18-Aug-03	1.37	18-Sep-03	1.97
19-Jun-03	5.31	19-Jul-03	3.08	19-Aug-03	1.3	19-Sep-03	2.04
20-Jun-03	5.14	20-Jul-03	4.54	20-Aug-03	1.26	20-Sep-03	2.13
21-Jun-03	4.89	21-Jul-03	4.86	21-Aug-03	1.21	21-Sep-03	2.22
22-Jun-03	4.69	22-Jul-03	3.71	22-Aug-03	1.17	22-Sep-03	2.32
23-Jun-03	4.56	23-Jul-03	3.14	23-Aug-03	1.15	23-Sep-03	2.42
24-Jun-03	4.52	24-Jul-03	2.76	24-Aug-03	1.15	24-Sep-03	2.53
25-Jun-03	4.7	25-Jul-03	2.49	25-Aug-03	1.43	25-Sep-03	2.64
26-Jun-03	6.59	26-Jul-03	2.29	26-Aug-03	2.06	26-Sep-03	2.75
27-Jun-03	9.51	27-Jul-03	2.17	27-Aug-03	2.16	27-Sep-03	2.86
28-Jun-03	7.97	28-Jul-03	2.14	28-Aug-03	1.86	28-Sep-03	2.98
29-Jun-03	8.09	29-Jul-03	2.1	29-Aug-03	1.59	29-Sep-03	3.1
30-Jun-03	7.5	30-Jul-03	2.05	30-Aug-03	1.42	30-Sep-03	3.22
		31-Jul-03	2	31-Aug-03	1.33		
June Mean	**7.04**	**July Mean**	**3.94**	**Aug Mean**	**1.58**	**Sept Mean**	**1.91**


WSC Stream Discharge Data (preliminary) for the Salmon River above the Diversion Dam, from June 1 to September 30, 2003
m3/s
Mean daily discharge
35
30
25
20
15
10
5
0
1-Jun-03
8-Jun-03
15-Jun-03
22-Jun-03
29-Jun-03
6-Jul-03
13-Jul-03
20-Jul-03
27-Jul-03
3-Aug-03
10-Aug-03
17-Aug-03
24-Aug-03
31-Aug-03
7-Sep-03
14-Sep-03
21-Sep-03
28-Sep-03


WSC Stream Discharge Data (preliminary) for the Salmon River above the Memekay confluence, from June 1 to September 30, 2003
m3/s
Mean daily discharge
14
12
10
8
6
4
2
0
1-Jun-03
8-Jun-03
15-Jun-03
22-Jun-03
29-Jun-03
6-Jul-03
13-Jul-03
20-Jul-03
27-Jul-03
3-Aug-03
10-Aug-03
17-Aug-03
24-Aug-03
31-Aug-03
7-Sep-03
14-Sep-03
21-Sep-03
28-Sep-03

APPENDIX 6.

Spot temperatures (and time) recorded in Paterson Creek in 2003 using a hand-held alcohol thermometer. Streamflow measured in Paterson Creek using a Marsh-McBirney streamflow meter, model 201.

Date (2003)	Water temperature °C.	Streamflow	
	Paterson – T100	Discharge (m^3/s)	Wetted width (m)
June 17	18° 15:45	0.23 m^3/s	5.5
June 23	15° 14:00	0.17 m^3/s	5.4
July 9	16.5°	0.04	4.6
July 16	15.5° 14:55		
July 17	17° 15:45	0.035	4.4
July 23	15.5° 11:25	*0.02	3.8
July 30	18.5° 15:00	*0.007	3.8
Aug 6	14.5° 12:30	*0.003	3.1
Aug 13	15° 14:05		
Aug 27	14 15:10		
Sept 10	12.5 13:25		

* Streamflow meter would not calibrate properly, even after new batteries were installed. Flows were too low to be measured reliably.

APPENDIX 7.

Fertilizer drip-rates of liquid 10-34-0 at stations on Grilse Creek, mainstem Salmon River and the Memekay River from June 17 to late August, 2003 The output rates (ml/min) and re-calibration rates (ml/min) are shown.

Date	Grilse Creek		Rock Ck.		Fish Screen		Mem ML bridge		Memekay R.	
2003	Out	Re-cal	Out	Re-cal	Out	Re-cal	Out	Re-cal	Out	Re-cal
Jun 17		6		10		12		10		6
Jun 21	5.2	6.0	19	11.6	11.0	7.4	2.4	7.4	10.3	5.0
Jun 23	5.4	4.8	11.5	7.8	6.4	7.8	3.7	6.6	4.6	3.6
Jun 26	4.2	3.2	7.2	12.0	7.4	9.5	2.6	11.4	3.1	3.1
Jun30	1.8	3.8	8.0	8.0	4.2	7.9	2.8	9.4	1.8	3.0
Jul 2	2.7	3.2	7.6	7.6	7.8	7.8	7.4	7.4	2.8	2.8
Jul 5	2.4	2.4	10.0	7.2	5.8	7.2	4.8	4.8	2.5	2.0
Jul 8	2.0	3.0	4.4	7.0	5.8	7.0	2.8	4.7	1.5	2.0
Jul 11	2.4	3.2	6.9	6.5	6.4	6.4	3.9	5.4	1.9	2.1
Jul 15	2.0	3.0							1.2	3.0
Jul 16	2.8	7.5					2.7	7.5		
Jul 17	2.4	4.0	5.2	6.0	2.4	6.2			2.8	2.8
Jul 22	2.7	3.1	5.2	5.2	2.4	5.9	3.2	6.5	2.0	2.8
Jul 25	2.4	2.4	5.0	5.0	4.0	4.0	4.0	5.6	2.6	2.6
Jul 28	2.2	2.2	4.4	4.4	2.5	5.0	4.0	4.0	2.0	2.4
Aug 1	1.4	2.5	2.9	2.9	3.2	3.2	2.6	4.6	1.4	1.4
Aug 5	1.8	2.7	3.4	4.7	0	4.4	2.8	4.5	0.8	1.8
Aug 8	2.0	2.0	0	4.2	0	3.8	2.8	2.8	1.0	2.2
Aug 11			2.5	4.1	0	4.8	1.9	4.6	1.2	1.9
Aug 15	2.1	2.1	3.8	3.8	5.2	5.2	3.6	3.6	2.0	2.0
Aug 18	1.7	1.7	3.7	3.7	3.4	4.2	3.4	3.4	1.4	1.7
Aug 21	1.4	1.4	0	4.6	2.2	3.6	1.8	4.4	1.4	2.4
Aug 25	Tank empty		2.0	5.0	0.6	6.0	2.0	5.0	1.4	4.0
Aug 29			Tank empty		2.2	4.4	4.4	4.4	3.0	2.2
Sept 5							1.8	empty	1.5	
Sept 6					1.3	empty				
Total Load	208 L (=68 days) av.- 3.1 ml/min		724 L (=72 days) av.– 10.1 ml/min		516 L (=81 days) av.– 6.4 ml/min		520 L (=80 days) av.– 6.5 ml/min		312 L (=80 days) av.– 3.9 ml/min	

The total load for the Salmon River watershed was 2280 L of 10-34-0.

APPENDIX 8.

Water chemistry results from samples of the mainstem Salmon River, Grilse Creek and the Memekay River: July 15, August 12 and September 7, 2003.

C.O.C. # 8140101									
Philip ID :	13033674	13033675	13033676	13033678	13033679	13033677	13033680		
Client ID :	**GRILSE CTRL**	**GRILSE BRIDGE(AF)**	**SALMON CTRL**	**SALMON WSC**	**PALLAN'S**	**MEMEKAY CTRL**	**MEMEKAY CTRL**		
GENERAL INORGANICS								unit	MDL
Alkalinity Total as CaCO3	14.6	14.9	11.5	13.1	13.5	26.1	16.5	mg/L	0.5
NITROGEN									
Ammonia Nitrogen (N)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	< 0.02	< 0.02	< 0.02	0.05	0.03	< 0.02	0.02	mg/L	
Nitrate+Nitrite (N)	0.011	0.004	< 0.002	0.05	0.026	< 0.002	0.022	mg/L	0.002
Nitrite Nitrogen (N)	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	mg/L	0.002
PHOSPHORUS									
Ortho-Phosphorus (P)	0.002	0.002	0.002	0.002	0.001	0.003	0.005	mg/L	0.001
Phosphorus Total Diss (P)	< 0.002	0.002	< 0.002	0.002	< 0.002	< 0.002	< 0.002	mg/L	0.002
Phosphorus Total (P)	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	mg/L	0.002
Sampled on:	**15/07/2003**	**15/07/2003**	**15/07/2003**	**15/07/2003**	**15/07/2003**	**15/07/2003**	**15/07/2003**		
Sampled at:	14:45	15:20	15:35	16:45	17:15	16:15	17:40		
C.O.C. # 8140105									
Philip ID :	13039742	13039743	13039744	13039740	13039738	13039741	13039739		
Client ID :	**GRILSE CTRL**	**GRILSE BRIDGE(SF)**	**SALMON CTRL**	**SALMON-WSC**	**PALLAN'S**	**MEMEKAY CTRL**	**MEMEKAY BRIDGE**		
GENERAL INORGANICS								Unit	MDL
Alkalinity Total as CaCO3	21.5	21.4	17.5	17	22.2	48	25.8	mg/L	0.5
NITROGEN									
Ammonia Nitrogen (N)	< 0.005	< 0.005	< 0.005	< 0.005	0.015	< 0.005	< 0.005	mg/L	0.005

Nitrate Nitrogen Diss (N)	0.05	0.02	< 0.02	0.13	0.05	0.12	0.09	mg/L	
Nitrate+Nitrite (N)	0.054	0.022	0.02	0.129	0.047	0.117	0.093	mg/L	0.002
Nitrite Nitrogen (N)	< 0.002	< 0.002	0.002	0.002	< 0.002	< 0.002	0.002	mg/L	0.002
Client ID :	**GRILSE CTRL**	**GRILSE BRIDGE(SF)**	**SALMON CTRL**	**SALMON-WSC**	**PALLAN'S**	**MEMEKAY CTRL**	**MEMEKAY BRIDGE**		
PHOSPHORUS									
Ortho-Phosphorus (P)	0.001	0.003	< 0.001	0.001	0.002	0.001	0.001	mg/L	0.001
Phosphorus Total Diss (P)	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.003	mg/L	0.002
Phosphorus Total (P)	< 0.002	< 0.002	< 0.002	0.002	< 0.002	< 0.002	0.004	mg/L	0.002
Sampled on:	**12/08/2003**	**12/08/2003**	**12/08/2003**	**12/08/2003**	**12/08/2003**	**12/08/2003**	**12/08/2003**		
Sampled at:	13:25	14:15	14:30	11:57	11:15	12:25	11:40		
C.O.C. # 8140109									
Philip ID :	13044475	13044476	13044477	13044479	13044480	13044478	13044481		
Client ID :	**GRILSE CTRL**	**GRILSE BRIDGE(SF)**	**SALMON CTRL**	**SALMON-WSC**	**PALLAN'S**	**MEMEKAY CTRL**	**MEMEKAY BRIDGE**		
GENERAL INORGANICS								unit	MDL
Alkalinity Total as CaCO3	21.6	20.2	20.1	18.4	18.1	45	26.5	mg/L	0.5
NITROGEN									
Ammonia Nitrogen (N)	0.006	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	0.06	0.05	0.07	0.06	0.04	0.04	0.07	mg/L	
Nitrate+Nitrite (N)	0.06	0.05	0.07	0.06	0.04	0.04	0.07	mg/L	0.002
Nitrite Nitrogen (N)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	mg/L	0.002
PHOSPHORUS									
Ortho-Phosphorus (P)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	mg/L	0.001
Phosphorus Total Diss (P)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	mg/L	0.002
Phosphorus Total (P)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	mg/L	0.002
Sampled on:	**07/09/2003**	**07/09/2003**	**07/09/2003**	**07/09/2003**	**07/09/2003**	**07/09/2003**	**07/09/2003**		
Sampled at:	11:20	11:55	12:15	13:20	13:45	12:50	14:10		

APPENDIX 9.

Water chemistry results from samples of Paterson Creek: July 16, July 23, July 30, August 6, August 13, August 20, August 27, September 10, and September 24, 2003.

Salmon River Fertilization – 2003					
Paterson Creek - Pollock Log Test					
C.O.C. # 8140101					
Philip ID :	13033681	13033682	13033683		
Client ID :	**PATERSON -T400**	**PATERSON -T100**	**PATERSON CTRL**		
GENERAL INORGANICS				Unit	MDL
Alkalinity Total as CaCO3	44.3	44	43.6	mg/L	0.5
NITROGEN					
Ammonia Nitrogen (N)	< 0.005	< 0.005	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	0.05	0.05	0.04	mg/L	
Nitrate+Nitrite (N)	0.054	0.052	0.041	mg/L	0.002
Nitrite Nitrogen (N)	< 0.002	< 0.002	< 0.002	mg/L	0.002
PHOSPHORUS					
Ortho-Phosphorus (P)	0.002	0.002	0.003	mg/L	0.001
Phosphorus Total Diss (P)	0.006	0.004	< 0.002	mg/L	0.002
Phosphorus Total (P)	< 0.002	0.004	< 0.002	mg/L	0.002
Sampled on:	**16-Jul-03**				
Sampled at:					
C.O.C. # 8140102					
Philip ID :	13035716	13035717	13035718		
Client ID :	**PATERSON-T400**	**PATERSON-T100**	**PATERSON CTRL**		
GENERAL INORGANICS				Unit	MDL
Alkalinity Total as CaCO3	48.1	47.3	47.3	mg/L	0.5
NITROGEN					
Ammonia Nitrogen (N	0.005	0.008	0.011	mg/L	0.005
Nitrate Nitrogen Diss (N)	0.07	0.06	0.05	mg/L	
Nitrate+Nitrite	0.069	0.064	0.053	mg/L	0.002
Nitrite Nitrogen (	0.002	0.002	0.003	mg/L	0.002
PHOSPHORUS					
Ortho-Phosphorus (P)	0.003	0.003	0.001	mg/L	0.001
Phosphorus Total Diss (P)	0.005	0.002	< 0.002	mg/L	0.002
Phosphorus Total (P)	0.002	0.004	< 0.002	mg/L	0.002
Sampled at:	**23-Jul-03**				

APPENDIX 9 (cont'd)

C.O.C. # 8140103					
Philip ID :	13037575	13037576	13037577		
Client ID :	**PATERSON-T400**	**PATERSON-T100**	**PATERSON-CTRL**		
GENERAL INORGANICS				Unit	MDL
Alkalinity Total as CaCO3	51.5	51.2	50.9	mg/L	0.5
NITROGEN					
Ammonia Nitrogen (N)	0.009	0.006	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	0.12	0.11	0.08	mg/L	
Nitrate+Nitrite (N)	0.117	0.112	0.081	mg/L	0.002
Nitrite Nitrogen (N)	< 0.002	0.002	0.002	mg/L	0.002
PHOSPHORUS					
Ortho-Phosphorus (P)	0.006	0.005	0.001	mg/L	0.001
Phosphorus Total Diss (P)	0.006	0.005	0.002	mg/L	0.002
Phosphorus Total (P)	0.005	0.006	< 0.002	mg/L	0.002
Sampled on:	**30-Jul-03**				
Sampled at:	13:55	14:25	14:45		
C.O.C. # 8140104					
Philip ID :	13038264	13038265	13038266		
Client ID :	**PATERSON-T400**	**PATERSON-T100**	**PATERSON CTRL**		
GENERAL INORGANICS				Unit	MDL
Alkalinity Total as CaCO3	55.2	54.7	56.5	mg/L	0.5
NITROGEN					
Ammonia Nitrogen (N)	< 0.005	< 0.005	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	0.12	0.11	0.08	mg/L	
Nitrate+Nitrite (N)	0.12	0.112	0.076	mg/L	0.002
Nitrite Nitrogen (N)	<0.002	< 0.002	< 0.002	mg/L	0.002
PHOSPHORUS					
Ortho-Phosphorus (P)	< 0.001	< 0.001	< 0.001	mg/L	0.001
Phosphorus Total Diss (P)	0.007	0.01	0.005	mg/L	0.002
Phosphorus Total (P)	0.005	0.008	0.004	mg/L	0.002
Sampled on:	**06-Aug-03**				
Sampled at:	11:45	12:10	12:35		
C.O.C. # 8140106					
Philip ID :	13039745	13039746	13039747		
Client ID :	**PATERSON-T400**	**PATERSON-T100**	**PATERSON-CTRL**		
GENERAL INORGANICS				Unit	MDL
Alkalinity Total as CaCO3	57.3	58.9	59	mg/L	0.5
NITROGEN					
Ammonia Nitrogen (N)	0.018	< 0.005	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	0.09	0.07	0.05	mg/L	
Nitrate+Nitrite (N)	0.093	0.071	0.055	mg/L	0.002
Nitrite Nitrogen (N	< 0.002	0.002	< 0.002	mg/L	0.002
PHOSPHORUS					
Ortho-Phosphorus (P)	< 0.001	< 0.001	< 0.001	mg/L	0.001
Phosphorus Total Diss (P)	< 0.002	0.003	< 0.002	mg/L	0.002
Phosphorus Total (P)	< 0.002	0.006	< 0.002	mg/L	0.002

Sampled on:	**13-Aug-03**				
Sampled at:	13:20	13:45	14:05		

APPENDIX 9 (cont'd)

C.O.C. # 8140107					
Philip ID :	13041347	13041348	13041349		
Client ID :	**PATERSON-T400**	**PATERSON-T100**	**PATERSON-CTRL**		
GENERAL INORGANICS				Unit	MDL
Alkalinity Total as CaCO3	61.5	63.6	64.7	mg/L	0.5
NITROGEN					
Ammonia Nitrogen (N)	< 0.005	< 0.005	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	0.13	0.12	0.09	mg/L	
Nitrate+Nitrite (N)	0.131	0.124	0.087	mg/L	0.002
Nitrite Nitrogen (N)	< 0.002	< 0.002	< 0.002	mg/L	0.002
PHOSPHORUS					
Ortho-Phosphorus (P)	0.002	< 0.001	0.002	mg/L	0.001
Phosphorus Total Diss (P)	0.002	0.006	0.003	mg/L	0.002
Phosphorus Total (P)	0.005	0.008	0.005	mg/L	0.002
Sampled on:	**20-Aug-03**				
Sampled at:	10:55	11:40	12:20		
C.O.C. # 8140108					
Philip ID :	13042946	13042947	13042948		
Client ID :	**PATERSON-T400**	**PATERSON-T100**	**PATERSON-CTRL**		
GENERAL INORGANICS				Unit	MDL
Alkalinity Total as CaCO3	62	63.4	64.1	mg/L	0.5
NITROGEN					
Ammonia Nitrogen (N)	< 0.005	< 0.005	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	0.07	0.07	0.05	mg/L	
Nitrate+Nitrite (N)	0.074	0.071	0.047	mg/L	0.002
Nitrite Nitrogen (N)	< 0.002	< 0.002	< 0.002	mg/L	0.002
PHOSPHORUS					
Ortho-Phosphorus (P)	< 0.001	0.002	< 0.001	mg/L	0.001
Phosphorus Total Diss (P)	< 0.002	0.003	< 0.002	mg/L	0.002
Phosphorus Total (P)	< 0.002	0.005	< 0.002	mg/L	0.002
Sampled on:	**27-Aug-03**				
Sampled at:	14:20	14:45	15:10		
C.O.C. # 8140110					
Philip ID :	13045324	13045325	13045326		
Client ID :	**PATERSON-T400**	**PATERSON-T100**	**PATERSON-CTRL**		
GENERAL INORGANICS				Unit	MDL
Alkalinity Total as CaCO3	60.8	61.3	61.9	mg/L	0.5
NITROGEN					
Ammonia Nitrogen (N)	< 0.005	< 0.005	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	0.04	0.03	0.03	mg/L	
Nitrate+Nitrite (N)	0.046	0.03	0.028	mg/L	0.002
Nitrite Nitrogen (N)	0.002	< 0.002	< 0.002	mg/L	0.002
PHOSPHORUS					
Ortho-Phosphorus (P)	< 0.001	< 0.001	< 0.001	mg/L	0.001
Phosphorus Total Diss (P)	< 0.002	0.009	< 0.002	mg/L	0.002
Phosphorus Total (P)	< 0.002	0.003	0.006	mg/L	0.002

Sampled on:		**10-Sep-03**			
Sampled at:	12:30	12:55	13:20		

APPENDIX 9 (cont'd)

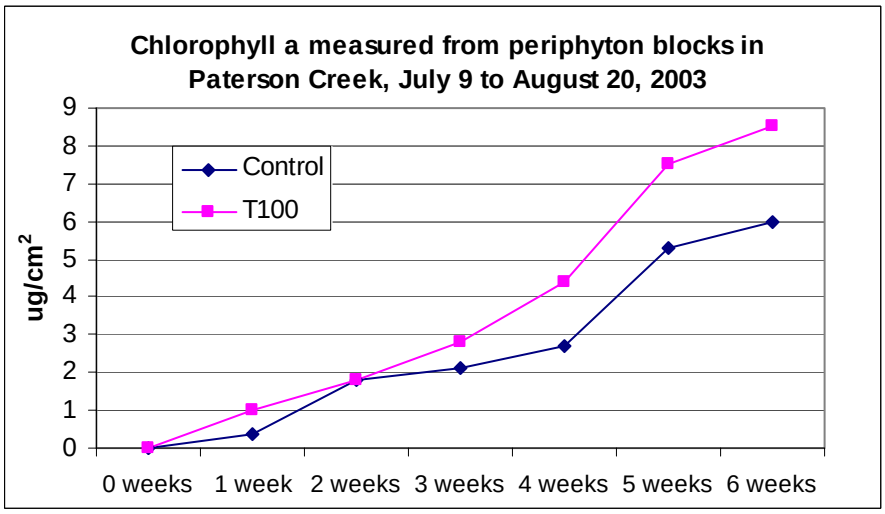
C.O.C. # 8140111					
Philip ID :	13048984	13048985	13048986		
Client ID :	**PATERSON-T400**	**PATERSON-T100**	**PATERSON-CTRL**		
GENERAL INORGANICS				Unit	MDL
Alkalinity Total as CaCO3	58	56.3	56.8	mg/L	0.5
NITROGEN					
Ammonia Nitrogen (N)	< 0.005	< 0.005	< 0.005	mg/L	0.005
Nitrate Nitrogen Diss (N)	<.02	0.03	0.03	mg/L	
Nitrate+Nitrite (N)	0.019	0.029	0.03	mg/L	0.002
Nitrite Nitrogen (N)	0.002	0.002	0.002	mg/L	0.002
PHOSPHORUS					
Ortho-Phosphorus (P)	0.001	0.001	0.001	mg/L	0.001
Phosphorus Total Diss (P)	< 0.002	0.002	< 0.002	mg/L	0.002
Phosphorus Total (P)	0.016	0.005	0.002	mg/L	0.002
Sampled on:		**24-Sep-03**			
Sampled at:	17:05	18:40	18:46		

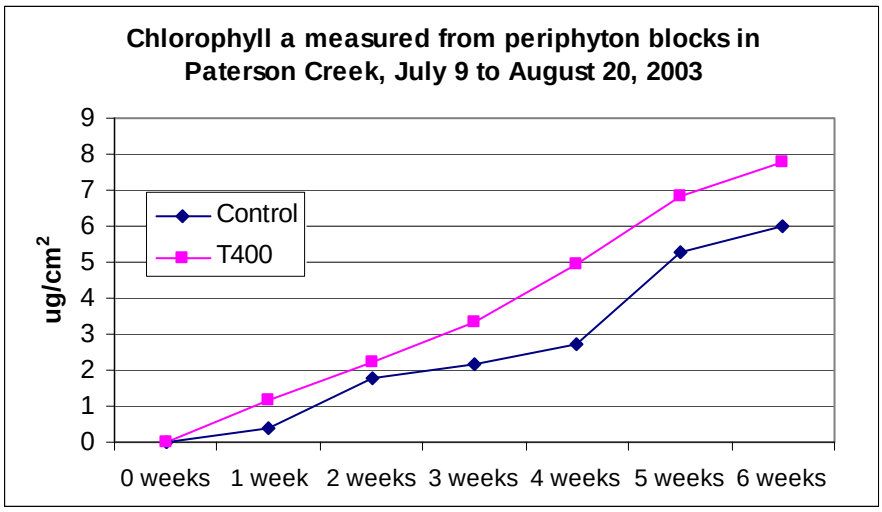
APPENDIX 10.

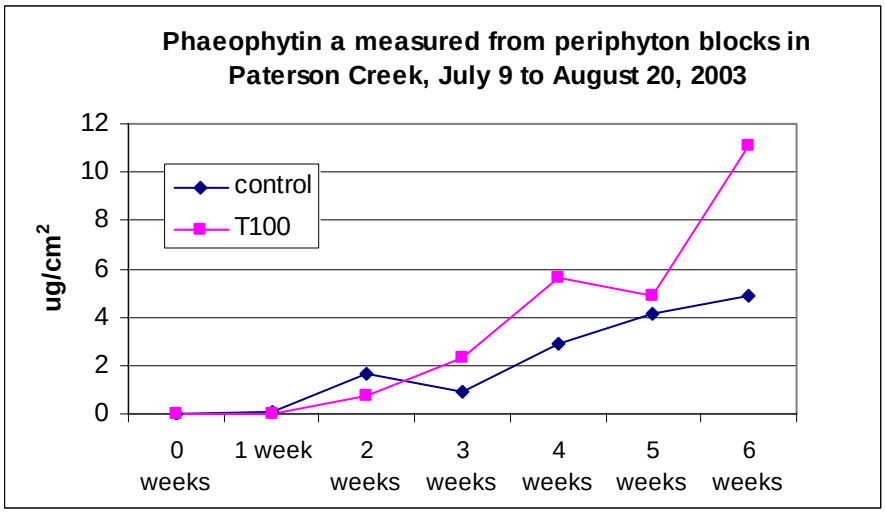
Chlorophyll *a* and phaeophytin *a* (µg·cm^{-2}) measured from periphyton samples of Paterson Creek: July 17, July 23, July 30, August 6, August 13, August 20, August 27, September 10, and September 24, 2003.

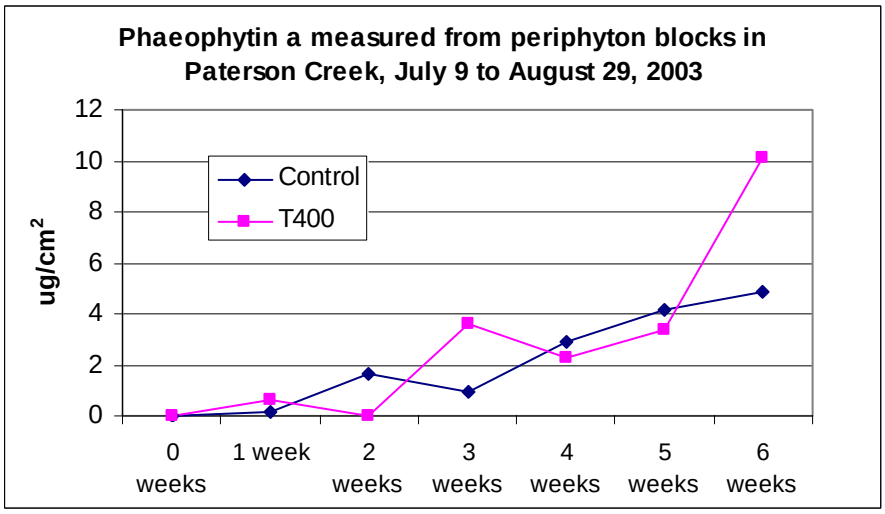
First periphyton Test – Paterson Creek, 2003. New foam placed July 9.

TEST (µg·cm^{-2})	Paterson Creek – Control					
	1 week	**2 weeks**	**3 weeks**	**4 weeks**	**5 weeks**	**6 weeks**
	17-Jul-03	23-Jul-03	30-Jul-03	6-Aug-03	13-Aug-03	20-Aug-03
Chlorophyll *a*	0.37	1.78	2.14	2.7	5.3	6
Phaeophytin *a*	0.12	1.62	0.94	2.87	4.15	4.88
	Paterson Creek – T100					
	1 week 17-Jul-03	**2 weeks** 23-Jul-03	**3 weeks** 30-Jul-03	**4 weeks** 6-Aug-03	**5 weeks** 13-Aug-03	**6 weeks** 20-Aug-03
Chlorophyll *a*	0.99	1.82	2.8	4.37	7.54	8.52
Phaeophytin *a*	<0.03	0.74	2.3	5.62	4.88	11.1
	Paterson Creek – T400					
	1 week 17-Jul-03	**2 weeks** 23-Jul-03	**3 weeks** 30-Jul-03	**4 weeks** 6-Aug-03	**5 weeks** 13-Aug-03	**6 weeks** 20-Aug-03
Chlorophyll *a*	1.19	2.24	3.34	4.95	6.83	7.76
Phaeophytin *a*	0.6	<0.03	3.62	2.3	3.34	10.1




Chlorophyll a measured from periphyton blocks in Paterson Creek, July 9 to August 20, 2003
ug/cm2
9
8
7
6
5
4
3
2
1
0
Control
T400
0 weeks
1 week
2 weeks
3 weeks
4 weeks
5 weeks
6 weeks

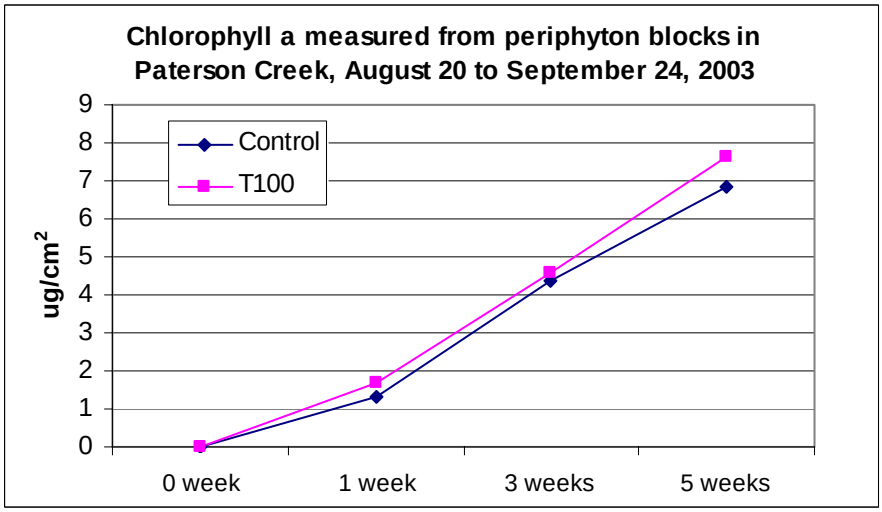

Phaeophytin a measured from periphyton blocks in Paterson Creek, July 9 to August 20, 2003
ug/cm2
12
10
8
6
4
2
0
control
T100
0 weeks
1 week
2 weeks
3 weeks
4 weeks
5 weeks
6 weeks

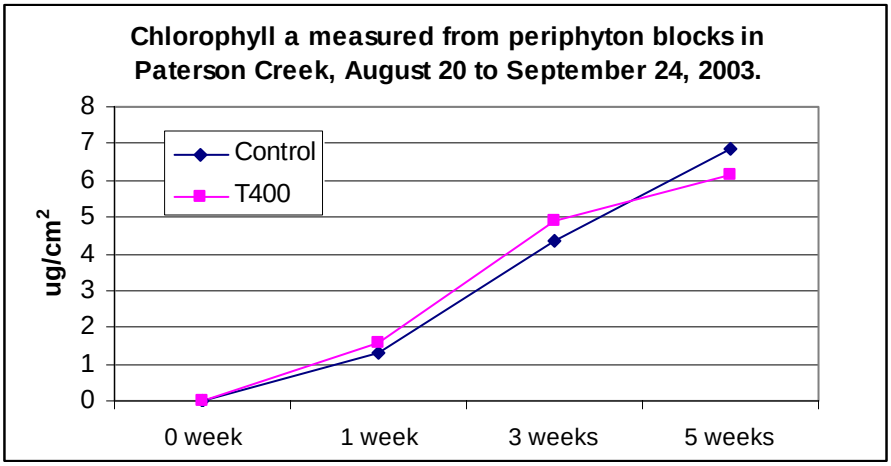

Phaeophytin a measured from periphyton blocks in Paterson Creek, July 9 to August 29, 2003
ug/cm2
12
10
8
6
4
2
0
Control
T400
0 weeks
1 week
2 weeks
3 weeks
4 weeks
5 weeks
6 weeks

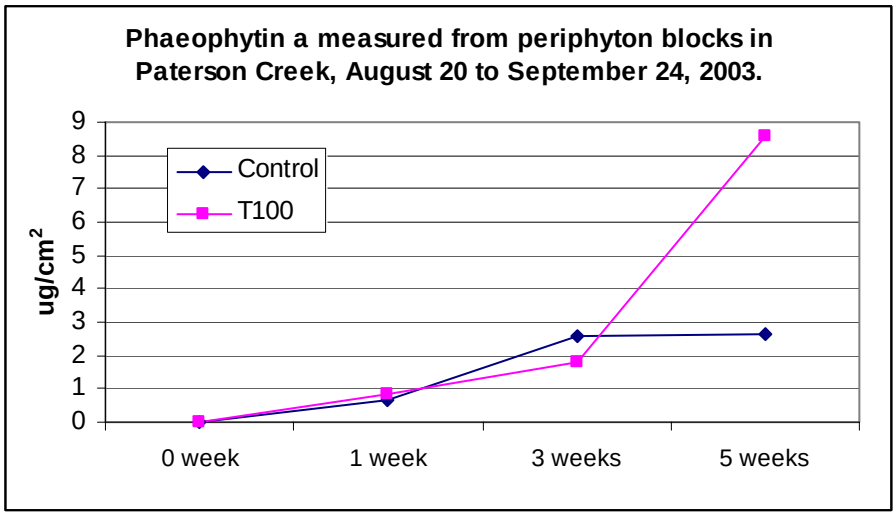
APPENDIX 10 (cont'd)

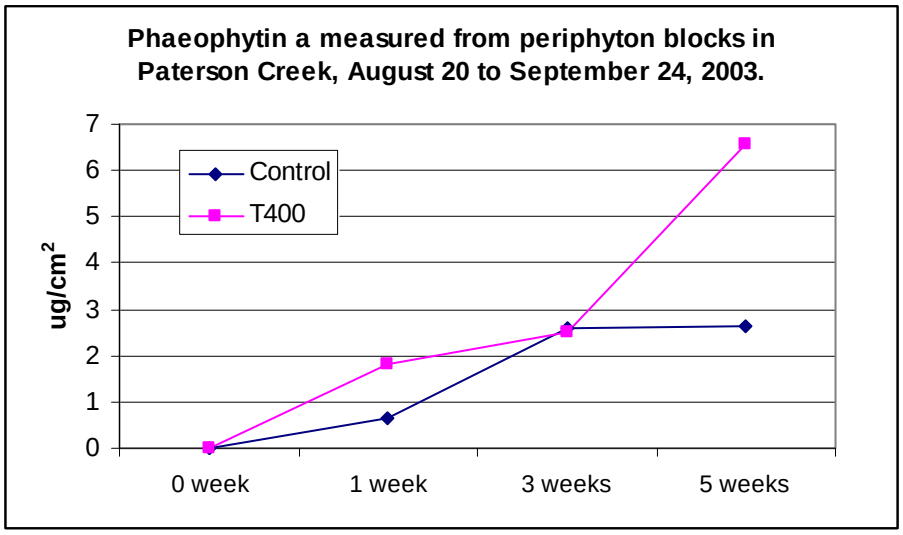
Second Periphyton Test – Paterson Creek, 2003. Foam replaced <u>August 20</u>.

TEST ($\mu g \cdot cm^{-2}$)	Paterson Creek – Control				
	1 week		**3 weeks**		**5 weeks**
	27-Aug-03		10-Sep-03		24-Sep-03
Chlorophyll *a*	1.33		4.37		6.83
Phaeophytin *a*	0.64		2.6		2.62
	Paterson Creek – T100				
	1 week 27-Aug-03		**3 weeks** 10-Sep-03		**5 weeks** 24-Sep-03
Chlorophyll *a*	1.69		4.59		7.64
Phaeophytin *a*	0.83		1.8		8.55
	Paterson Creek – T400				
	1 week 27-Aug-03		**3 weeks** 10-Sep-03		**5 weeks** 24-Sep-03
Chlorophyll *a*	1.58		4.92		6.14
Phaeophytin *a*	1.83		2.51		6.55


Chlorophyll a measured from periphyton blocks in Paterson Creek, August 20 to September 24, 2003
ug/cm2
9
8
7
6
5
4
3
2
1
0
Control
T100
0 week
1 week
3 weeks
5 weeks


Chlorophyll a measured from periphyton blocks in Paterson Creek, August 20 to September 24, 2003.
ug/cm2
8
7
6
5
4
3
2
1
0
Control
T400
0 week
1 week
3 weeks
5 weeks


Phaeophytin a measured from periphyton blocks in Paterson Creek, August 20 to September 24, 2003.
ug/cm2
9
8
7
6
5
4
3
2
1
0
Control
T100
0 week
1 week
3 weeks
5 weeks


Phaeophytin a measured from periphyton blocks in Paterson Creek, August 20 to September 24, 2003.
ug/cm2
7
6
5
4
3
2
1
0
Control
T400
0 week
1 week
3 weeks
5 weeks

APPENDIX 11.

Results of juvenile fish sampling in the mainstem Salmon River, Grilse Creek, Memekay River and Paterson Creek in September, 2003.

Location of juvenile fish sampling sites in the Salmon River watershed and size dimensions in 2003.

Watershed: Salmon Stream Code: 925-725300								
						Site Dimensions		
System	**Site #**	**Site Description**	**Site Reference (km)**	**Date (dd/mmm/yy)**	**UTM Code**	**Length**	**Width**	**Area**
Salmon	1	Pallan's	12.24	25-Sep-03	293530,5576518	12.9	8.6	109.4
Salmon	2	WSC Station (Kay Creek)	35.44	25-Sep-03	304045,5564254	13.7	8.1	111.2
Salmon	3	Memekay ML Bridge	52.6	11-Sep-03	309222,5556664	15.9	5.3	80.4
Salmon	4	Smolt Screen	58.02	26-Sep-03	309046,5552313	17.5	5.0	78.0
Salmon	5	Washout	67.73	11-Sep-03	302790,5548002	22.0	5.8	111.8
Salmon	6	Washout 500 m u/s of Grilse confluence	69.25	10-Sep-03	301495,5547162	12.4	6.9	78.9
Salmon	7	Memekay River (lower bridge)	27.93	25-Sep-03	302065,5566098	17.7	5.4	85.6
Salmon	8	Grilse Ck (100 m u/s of lower bridge)	70.77	10-Sep-03	300281,5547288	17.0	5.4	90.6
Salmon	9	Grilse Ck (300 m d/s of upper bridge)	74.27	12-Sep-03	297264,554698	14.6	6.4	89.1
Salmon	10	Grilse Ck (1 km u/s of upper bridge)	75.91	12-Sep-03	296047,5546134	16.9	5.8	95.2

Salmon

Juvenile Steelhead Electrofishing Results

Alkalinity=
Biomass=

1998

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.25	189.8	201.90	65.5	308%
2	4.01	31.76	52.10	36.8	142%
3	3.79	63.45	64.10	38.9	165%
4	3.48	60.42	67.10	42.4	158%
5	3.13	75.06	97.50	47.1	207%
6	2.33	27.87	37.20	63.3	59%
7	4.03	25.9	41.10	36.6	112%
8	3.52	49.2	54.70	41.9	131%
9	2.98	20.96	27.60	49.5	56%
10	3.56	34.47	51.10	41.4	123%
MEAN	**3.31**		**59.11 ***		**146%**

1999

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	1.44	59.5	104.40	102.4	102%
2	2.79	42.4	64.30	52.8	122%
3	2.81	10.1	12.00	52.5	23%
4	1.04	26.8	29.50	141.8	21%
5	1.50	18.5	19.90	98.3	20%
6	1.09	11.8	17.90	135.3	13%
7	1.46	21.6	24.60	101.0	24%
8	1.60	64.3	69.20	92.2	75%
9	1.52	16.9	19.40	97.0	20%
10	1.00	49.5	56.30	147.5	38%
MEAN	**1.63**		**33.09 ***		**46%**

* geometric mean

APPENDIX 11 (cont'd)

2000

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.83	72.0	130.36	52.0	250%
2	4.70	21.1	50.11	31.3	160%
3	4.31	35.2	133.29	34.2	390%
4	5.25	13.0	15.45	28.1	55%
5	2.98	31.2	43.25	49.4	88%
6	6.63	9.0	11.69	22.2	53%
7	4.30	15.2	17.39	34.3	51%
8	3.71	23.8	31.15	39.7	78%
9	4.62	11.8	16.27	31.9	51%
10	1.46	23.8	25.25	100.8	25%
MEAN	**4.08**		**32.96 ***		**120%**

2001

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.02	46.1	56.84	48.7	117%
2	4.77	22.2	28.52	30.9	92%
3	4.88	32.2	53.29	30.2	176%
4	3.96	18.8	31.76	37.3	85%
5	2.33	81.6	121.04	63.3	191%
6	2.04	13.0	18.02	72.3	25%
7	3.20	37.0	58.91	46.1	128%
8	3.11	60.2	77.94	47.3	165%
9	2.89	31.7	43.95	51.0	86%
10	1.21	55.8	83.14	122.2	68%
MEAN	**3.14**		**50.14***		**113%**

* geometric mean

APPENDIX 11 (cont'd)

2002

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.27	32.5	50.56	45.1	112%
2	3.89	22.6	38.54	37.9	102%
3	3.32	61.7	104.68	44.4	236%
4	4.44	7.5	10.31	33.2	31%
5	4.42	2.9	4.38	33.3	13%
6	2.96	11.4	19.71	49.9	40%
7	3.28	33.8	57.43	44.9	128%
8	3.34	34.3	51.14	44.2	116%
9	2.07	21.5	48.06	71.3	67%
10	1.02	22.4	28.17	144.4	20%
MEAN	**3.20**		**30.61***		**86%**

2003

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.37	22.9	34.19	43.8	78%
2	4.87	13.8	18.89	30.3	62%
3	5.01	43.2	58.97	29.4	200%
4	4.71	49.4	96.12	31.3	307%
5	2.53	29.6	48.21	58.3	83%
6	3.35	6.3	9.50	44.1	22%
7	5.27	22.5	28.12	28.0	101%
8	5.69	19.1	24.43	25.9	94%
9	4.78	12.5	18.59	30.9	60%
10	1.87	37.8	71.92	79.0	91%
MEAN	**4.14**		**33.02***		**110%**

* geometric mean