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YAKAMA RESERVATION WATERSHEDS PROJECT
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I. Introduction

A. Project Overview

In June of 2005, the Ahtanum Watershed Assessment, Toppenish Watershed and Satus Watershed Projects were combined into one project, named the Yakama Reservation Watersheds Project (YRWP.)
Since the last report in 2006, YRWP staff have continued several tasks including close monitoring of stream discharge and irrigation withdrawals, monitoring of juvenile steelhead and coho outmigration, steelhead spawning surveys and analysis of irrigation extent and timing. We have also begun new projects including a large riparian fencing project, experimental floodplain roughness projects using straw bales, and streamside revegetation at several locations along Ahtanum Toppenish and Satus Creeks.

II. Collect Data

A. Screw Traps

We monitored steelhead juvenile out migration (abundance, timing, and survival) in Toppenish Creek, Satus Creek and Ahtanum Creek using three 5 foot diameter rotary screw traps each situated below all known steelhead spawning habitat in each respective tributary. Traps were operated between mid November and the first week of June each year. Flow is often to low at other times (i.e. June- October) of the year making operation during this period.

All Juvenile steelhead were anesthetized in MS-222 before being handled. They were then enumerated, measured (mm), and weighed (g). Scales were collected on 100 individuals. We also collected fin clips from 100 individuals from Satus and Toppenish Creek. These samples were sent to CRITFC for DNA analysis. They now have three years of data in hand to compare populations. On several occasions when large catches occurred (N > 200) only a random sub-sample were measured and weighed. We inserted PIT tags into a sub-sample of captured steelhead smolts over 100mm in length. Fish were then released at least 100 meters downstream from the screw trap after data was collected. Some PIT tagged fish were released several hundred meters upstream from the trap to estimate the efficiency (i.e. Mark-Recapture). Our goal was to perform at least one efficiency test per week at each trap, although low capture rates sometimes prevented this. Physical data (water temperature, air temperature, and percent cloud cover) were recorded. The trap rotation rate (seconds per 1 revolution) was recorded to evaluate operating efficiency.

<u>Satus Creek</u>

The screw trap on Satus creek was deployed at river mile (RM) 1 on November 30th 2006 and was operated continuously until June 6, 2007. The screw trap was in place for a total of 189 days. On several occasions during the period of operation, the cone on the trap had to be lifted when discharge and instream debris levels were high to avoid clogging, damage to the trap, and harm to out-migrating juveniles. Conditions for operation were suitable at this site for 90 % of the days (170) during the season. During the interval between visits to the trap, debris stopped the cone 42 % of the time. Steelhead smolts were captured on 54 days during the season (17 % of operating days). The mean rotation time for the screw trap was lower this year (23.17 seconds per rotation) compared with last year (14.42 seconds per rotation). The mean staff gage reading was 2.05—nearly the same as last year. The trap may not be rotating as easily due to wear and tear from two years with high flow events.

During the 2006-2007 season a total of 301 steelhead juveniles were captured in the screw trap at Satus Creek (table 1.) We implanted 129 PIT tags into captured fish. Thirty-six of PIT tagged juveniles were released upstream for an efficiency test. None of these were recaptured. Next season we hope to increase our efficiency rate by using sandbags to direct flow into the screw trap cone. We searched for a better location in summer 2007 but could not find one with suitable access for deploying a screw trap. The channel at this location has narrowed somewhat over the last year; however physical improvements (sand bag weir or more permanent structures) may be needed get a good out-migration estimate at this location.

The peak in daily catches occurred in December after an early winter storm caused a high flow event. Numbers captured in the trap waned in January than increased in early March and remained consistent through that month and then decreased again in April. Catches improved slightly compared to the 2006 season, although efficiency tests indicate that many out-migrating steelhead smolts can avoid our trap.

The mean fork length of juvenile steelhead increased during the spring months compared to the early months of December, January, and February. Overall mean fork length (102.2 mm) was lower than 2006 (130.2 mm). This figure was influenced by a large number of smaller juveniles migrating through the trap zone in December. We aged 48 steelhead juveniles. Most steelhead juveniles (86%) were age 1. The remaining juveniles (14%) were age 2.

Table 1. Number of steelhead captured per month in Satus Creek.

Statistic	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	0	129	35	17	102	17	1	0	301
% of total	0.0%	42.9%	11.6%	5.6%	33.9%	0.0565	0.3%	0.0%	100.0%
Max Fork Length	.	181.0	145.0	115.0	183.0	190	127.0	.	190.0
Min Fork Length	.	62.0	66.0	65.0	68.0	92	127.0	.	62.0
Mean Fork Length	.	97.2	89.0	88.8	108.5	138.65	127.0	.	102.2
Max Weight	.	60.6	29.8	35.0	62.5	67.4	18.8	.	67.4
Min Weight	.	2.3	2.9	2.4	3.2	6.9	18.8	.	2.3
Mean Weight	.	10.8	7.9	9.1	15.4	29.2	18.8	.	13.1
Mean Cond.Factor	.	1.089	1.059	1.435	1.018	0.987	0.918	.	1.074
Number tagged	.	47	6	7	53	15	1	.	129.0
% monthly catch tagged	.	36.4%	17.1%	41.2%	52.0%	0.8824	100.0%	.	42.9%

Toppenish Creek

The screw trap on Toppenish creek was deployed at river mile (RM) 22.6 on November 12th 2006 and was operated continuously until June 6, 2007. The screw trap was in place for a total of 201 days. On several occasions during the period of operation, the cone on the trap had to be lifted when discharge and in-stream debris levels were high to avoid clogging, damage to the trap, and harm to out-migrating juveniles. During the period of operation, the trap was checked daily in the mornings including weekends and most holidays. The rotation of the screw trap was often obstructed by woody debris generated by beaver activity upstream from the trap location.

We operated the Toppenish Creek screw trap for a 201 day period. High discharge and debris prevented operation of the screw trap for a prolonged 38 day period in March and early April. Operation of the screw trap was also halted during several other intervals of high flow in December, January, and February. Although the trap was in place, the cone was deployed for only 134 days (67% of the operating period). The trap was operating efficiently (i.e. deployed and cone rotating for the entire 24 hour period) on 91 days or 45 % of the time. Steelhead were captured on 109 days (81 %) out of the 134 days when the trap was deployed.

We capture 2384 juvenile steelhead during the 2006-2007 season. This is lower than the 2005-2006 season when we captured 2546 steelhead juveniles. Out of captured individuals, we inserted PIT tags into 687. Because the screw trap was deemed to be operating more efficiently in the 2006-2007 season, it is likely that actual steelhead out-migration numbers were lower in than in the previous year. Efficiency tests with PIT tagged steelhead indicate a higher trap efficiency rate (13.82%) than in the 2005-2006 season (9.66 %). An extrapolation on our catch numbers suggest that approximately 17,256 steelhead juveniles migrated through our trap zone during the 2006-2007 season. However, this estimate is certainly low because of the long intervals when the trap could not be deployed due to high flows. Several years of smolt trap data from three locations in the Yakima River basin indicate that steelhead outmigration peaks follow peaks in the hydrograph. This pattern was observed at the Toppenish Creek trap (figure 1.) Unfortunately, we are often unable to trap during this period because of concerns for staff safety, trap damage, and steelhead mortality events. It is difficult to discuss outmigration estimates and patterns with the numerous breaks in the continuous trapping regime that occurred in 2007.

Mean fork lengths increased during the spring months of April and May – a typical pattern seen in previous years and at other trap locations. Mean fork length was comparable (106.19 mm) to the 2005-2006 season (105.78), but lower than the 2004-2005 season (137.00 mm). It appears that during years when high flows occur early in the season (i.e. November and December) a large number of small (<100mm) probable age 0 steelhead juveniles get flushed downstream out of their normal summer rearing areas located upstream from our trap location. It is unknown what becomes of these early migrants. Comparable to 2006, 86 % of aged outmigrants were age 1 and 14% were age

2. This age at outmigration is also identical to what was observed at our Satus Creek trap.

Steelhead mortality was lower in 2007 (1.76 %) than in 2006 (10.76 %) and similar to previous years because we managed to halt trapping before the occurrence of major flood events.

In addition to the target species steelhead trout (Oncorhynchus mykiss), redside shiners (Richardsonius balteatus), speckled (Rhinichthyus osculus) and longnose dace (R. cataractae), chiselmouth (Achrocheilus alutaceus), northern pikeminnow (Ptychocheilus oregonensis), suckers (Catostomus spp.), sculpin (Cottus spp.), goldfish (Carassius auratus), carp (Cyprinus carpio), bluegill (Lepomis macrochirus), pumpkinseed (Lepomis gibbosus), lamprey (Entoshpenus spp.) Black Bulhead (Ictulurus nebulosis) were captured in 2007 or have been captured in past years at the Toppenish Creek trap.

Table 2. Number of steelhead captured per month in Toppenish Creek.

Stat	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	357	1284	332	167	26	113	102	3	2384
% of total	15.0%	53.9%	13.9%	7.01%	1.1%	4.7%	4.3%	0.1%	100%
Max Fork Length	195	192	160.00	192.00	167.00	195.00	185.00	160.00	195.00
Min Fork Length	62	53.00	45.00	61.00	77.00	77.00	90.00	81.00	45.00
Mean Fork Length	110.87	98.76	96.34	96.02	108.38	146.84	149.30	126.67	106.19
Max Weight	69.7	90.00	39.50	66.90	47.70	71.90	64.20	39.00	90.00
Min Weight	2.7	2.00	1.90	2.30	4.20	5.10	7.80	5.50	5.50
Mean Weight	14.9	11.14	10.10	9.80	14.56	32.59	35.16	24.90	14.19
Mean Cond.Factor	0.997	1.04	1.08	0.99	0.99	0.96	1.01	1.04	1.03
Number tagged	167.0	209.00	57.00	40.00	13.00	105.00	94.00	2.00	687.00
% monthly catch tagged	46.78%	16.28%	17.17%	23.95%	50.00%	92.92%	92.16%	66.67%	28.82%
%of total	7.01%	8.77%	2.39%	1.68%	0.55%	4.40%	3.94%	0.08%	28.82%

<u>Ahtanum Creek</u>

The screw trap on Satus creek was deployed at river mile (RM) 2 on December 5, 2006 and was operated continuously until June 5, 2007. The srcew trap was in place for a total of 181 days. On several occasions during the period of operation, the cone on the trap had to be lifted when discharge and in-stream debris levels were high to avoid clogging, damage to the trap, and harm to out-migrating juveniles. Only 11 steelhead smolts were captured in 2007 (table 3). Most of these were larger individuals above 150 mm. Although trap location was moved last year, which could affect catches; larger sizes and lengths of individuals captured seem to indicate a deficient 2005 year class. Of aged juveniles, only three were age 1. All fish were PIT tagged and released; however, too few fish were captured to analyze interrogations. In addition to steelhead trout, 12 chinook salmon smolts were captured in the screw trap.

Table 3. Number of steelhead captured per month in Ahtanum Creek.

Statistic	Nov	Dec	Jan	Feb	March	April	May	June	Overall
Monthly Catch	.	0	1	0	0	6	3	1	11
% of total	.	0.00%	9.09%	0.00%	0.00%	54.55%	27.27%	9.09%	100.00%
Max Fork Length	.	.	150.0	.	.	238.0	203.0	189.0	238.0
Min Fork Length	.	.	150.0	.	.	173.0	154.0	189.0	150.0
Mean Fork Length	.	.	150.0	.	.	207.3	182.3	189.0	193.6
Max Weight	.	.	32.1	.	.	124.0	93.5	65.1	124.0
Min Weight	.	.	32.1	.	.	56.8	43.7	65.1	32.1
Mean Weight	.	.	32.1	.	.	90.2	69.6	65.1	77.0
Mean Cond.Factor	.	.	0.951	.	.	1.08	1.12	0.96	1.02
Number tagged	.	.	1	.	.	6	3	1	11
% monthly catch tagged	.	.	100.0%	.	.	100.0%	100.0%	100.0%	100.0%

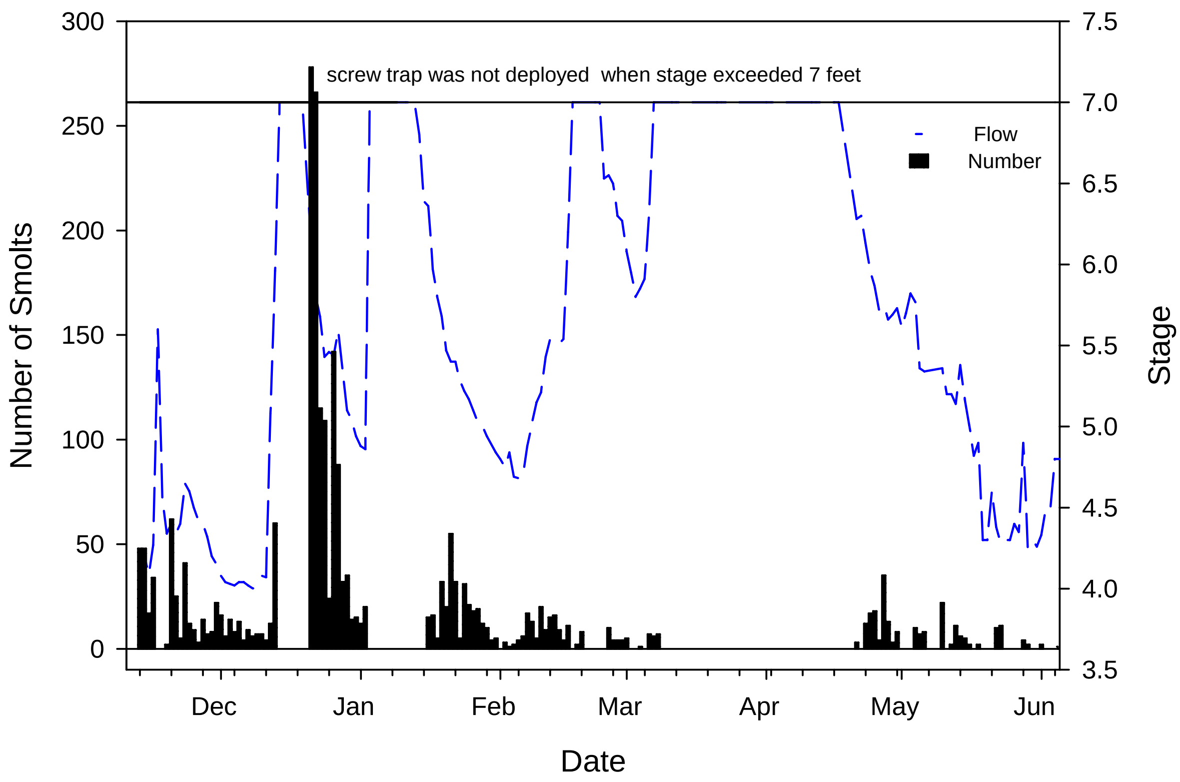

Figure1. Steelhead juvenile catches compared to creek stage at the Toppenish Screw trap.

B. Snorkeling

To assess the effectiveness of established minimum instream flows on steelhead trout in the Toppenish Creek Basin, we snorkeled several segments situated upstream and downstream from one irrigation diversion on Toppenish Creek (Lateral) and one on the N. Fork of Simcoe Creek (Hoptowit). These sites were established in 2005.

Currently there is a minimum instream flow of 12 cfs (cubic feet per second) below the Lateral diversion dam located at RM (river mile) 44.2. Before 2001, this irrigation ditch frequently dewatered the reach of Toppenish Creek immediately below the dam. After 2001, with the minimum instream flow of 10 cfs, approximately 2.3 miles of additional stream habitat below the diversion was watered and available for steelhead juveniles. Redds are typically observed in this reach during annual spawning ground surveys. The minimum instream flow requirement was increased from 10 cfs to 12 cfs in 2006. This resulted in some lengthening of the wetted reach, but Toppenish Creek continued to dry up two miles downstream atop its highly permeable alluvial fan whenever the flow past the Lateral Diversion remains below 15 cfs for an extended period. In 2007, the diversion was operated to maintain surface water at Signal Peak road which was deemed to be the driest reach. About 17 cfs was needed to keep the stream watered during the warmer summer months.

We established 200-meter snorkel segments downstream from the Lateral Diversion and a 100 meter snorkel segment upstream of the diversion. We also established a 200-meter segment approximately 1.5 miles downstream from the Lateral Diversion intake directly upstream from the abandoned 3-Way diversion. The 200 meter segments contained at least 2 pools and 2 riffles, probably changing little in morphology during our study. Six widths from the wetted edge were measured along each segment and used to calculate the area and corresponding steelhead densities. Surveyors moved in an upstream direction from the bottom of a survey segment to the top. One person followed behind to record data. Toppenish Creek is relatively wide at all three study segments requiring the use of two surveyors to effectively cover the entire width. However, many “blind spots” or areas obscured by rocks or shallow areas probably contained fish that went unobserved and not tallied. Due to these limitations, numbers of steelhead, particularly age 0 juveniles, were likely underestimated. Steelhead/rainbow trout *(O. mykiss)* were placed into either an Age 0 category for individuals that hatched in the spring or an age 1+ category for those that likely hatched in previous years. Under most conditions these two age classes of steelhead/rainbow trout were distinguishable. Unfortunately, we can not visually distinguish between anadromous steelhead and resident rainbows at these life stages. Surveys were repeated each month from June to October to assess the possible movement or shifts in spatial and temporal distribution.

Densities of juvenile steelhead observed during snorkel surveys were lower in 2007 compared to both 2005 and 2006 (Table 3.) Lower spawning intensity in the stream reach where snorkel surveys were conducted may have accounted for the difference in 2007. Fewer redds were located in this reach in 2007 than in the other years. Although redd counts for the entire watershed were higher in 2007 than in 2006, more steelhead redds were located in the upper watershed in 2007—further removed from our study site. Densities peaked above the diversion in July, which was similar to what was observed in 2005 and 2006. At our lower sites, densities were highest in October. Unlike 2005 and 2006, when the highest densities were observed at the three-way site; densities were higher at the sites further upstream in 2007 until October. The reasons for fewer fish at the three-way site in 2007 than the previous two years of the study are unknown. Movement of fish into this reach from downstream (below Wesley Rd.; RM 41) sections as they begin to dry in June may have resulted in an accumulation of Age 0 parr at the three-way site in 2005 and 2006. Also, fewer steelhead redds were identified in the vicinity of the Lateral Diversion. In 2007, the redd location furthest downstream on the Toppenish Creek mainstem was directly below the lateral diversion. During the previous two years of the study, Redds were located farther downstream. Because of higher flows in this reach resulting from reduced withdrawals to maintain higher in-stream flows in 2007, Toppenish Creek remained watered up for its entire length for most of the season. Continuous flow through this reach allowed juveniles to move downstream beyond our survey transect reducing the accumulation affect seen in 2005 and 2006. Juveniles were seen as far downstream as Signal Peak Road in July — a distance of 4 miles downstream from the nearest steelhead redd directly below the diversion in 2007.

In all three years of our study, there appeared to be a pattern of Age 1+ (smolt sized) steelhead parr densities increasing during the fall months. In 2005, the increase in smolt sized parr was between June and October was substantial. Although a slight increase was also seen in 2006, this pattern was less pronounced. Again, an increase of age 1+ juveniles were observed at these sites was seen in 2007. These smolt sized steelhead are seen congregating in pools and are possibly staging for their downstream migration when flows increase during late fall and winter.

Table 3. Snorkel survey rainbow/steelhead (*O. Mykiss*) numbers and densities at irrigation diversions in Toppenish Creek (Lateral) and the North Fork of Simcoe Creek (Hoptowit) **2005**.

2005	Age 0	Age 0	Age 0	Age 0	Age 0	Age 1 +	Age 1 +	Age 1 +	Age 1 +	Age 1 +
Number	Above Lateral (100m)	Below Lateral (100m)	Above three way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)	Above Lateral (100m)	Below Lateral (100m)	Above Three Way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)
June	70	163	235	0	0	37	12	0	21	45
July	85	97	404	0	0	5	7	5	22	23
August	136	212	572	0	0	47	39	25	30	23
September	70	111	394	0	0	23	59	95	32	43
October	75	49	300	.	.	38	102	98	.	.
Density (per 100 m²)										
June	9.54	20.05	13.37	0.00	0.00	5.04	1.48	0.00	3.04	6.48
July	11.58	11.93	22.98	0.00	0.00	0.68	0.86	0.28	3.19	3.31
August	18.53	26.08	32.54	0.00	0.00	6.40	4.80	1.42	4.35	3.31
September	9.54	13.65	22.41	0.00	0.00	3.13	7.26	5.40	4.64	6.20
October	10.22	6.03	17.06	.	.	5.18	12.55	5.57	.	.

Table 4. Snorkel survey rainbow/steelhead (*O. mykiss*) numbers and densities at irrigation diversions in Toppenish Creek (Lateral) and the North Fork of Simcoe Creek (Hoptowit) **2006.**

2006	Age 0	Age 0	Age 0	Age 0	Age 0	Age 1 +	Age 1 +	Age 1 +	Age 1 +	Age 1 +
Number	Above Lateral (100m)	Below Lateral (200m)	Above three way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)	Above Lateral (100m)	Below Lateral (200m)	Above Three Way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)
June	0	13	104	.	.	13	37	2	.	.
July	18	105	249	127	75	2	10	14	15	6
August	47	257	472	96	75	16	13	9	10	10
September	39	241	475	99	39	7	55	27	8	9
October	55	159	267	.	.	15	46	61	.	.
Density (per 100 m²)										
June	0.00	0.80	5.92	.	.	1.77	2.28	0.11	.	.
July	2.45	6.46	14.16	18.41	10.81	0.27	0.62	0.80	2.17	0.86
August	6.40	15.81	26.85	13.91	10.81	2.18	0.80	0.51	1.45	1.44
September	5.31	14.82	27.02	14.35	14.35	0.95	3.38	1.54	1.16	1.30
October	7.49	9.78	15.19	.	.	2.04	2.83	3.47	.	.

Table 5. Snorkel survey rainbow/steelhead (*O. mykiss*) numbers and densities at irrigation diversions in Toppenish Creek (Lateral) and the North Fork of Simcoe Creek (Hoptowit) **2007**.

2007	Age 0	Age 0	Age 0	Age 0	Age 0	Age 1 +	Age 1 +	Age 1 +	Age 1 +	Age 1 +
Number	Above Lateral (100m)	Below Lateral (200m)	Above three way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)	Above Lateral (100m)	Below Lateral (200m)	Above Three Way (200m)	Below Hoptowit (200m)	Above Hoptowit (200m)
June	68	189	68	55	6	16	20	0	27	64
July	108	44	5	32	42	3	16	0	42	41
August	100	144	118	63	60	30	31	12	43	39
September	102	160	157	62	98	35	36	30	46	40
October	69	204	277	.	.	22	47	60	.	.
Density (per 100 m²)										
June	8.11	11.24	3.58	7.64	.66	1.91	1.19	0.00	3.75	7.00
July	12.89	2.62	0.26	4.44	4.60	0.36	0.95	0.00	5.83	4.49
August	11.93	8.56	6.20	8.75	6.56	3.58	1.84	0.63	5.97	4.27
September	12.17	9.51	8.25	8.61	10.72	4.18	2.14	1.58	6.39	4.38
October	8.23	12.13	14.56	.	.	2.63	2.79	3.15	.	.

Hoptowit Diversion at N. Fork of Simcoe Creek

We used the same method utilized at the Toppenish Creek Lateral Diversion to monitor relative abundance above and below the Hoptowit diversion located on the North Fork of Simcoe Creek less than one mile above the confluence with the South Fork. This diversion was modified with screens and a head-gate in 2004. This diversion and three others downstream can withdraw a significant amount of water from Simcoe Creek, although diversion quantities have been reduced in recent years. Withdrawal affects water temperature downstream from the diversions, although the increase is gradual. The segment length was 200 m and the width of this stream is relatively small so only one snorkel surveyor was needed. This portion of Simcoe Creek is well shaded affecting the visibility during snorkeling and making identification difficult at times. However, in three years of study no salmonids other than O. mykiss were observed. A size difference between Age 0 juveniles and older year classes (Age 1+) could still be observed at this location.

Densities of Age 0 steelhead were higher below the Hoptowit irrigation diversion than above it during the first three monthly surveys (Table 5.) In October 2007 density was higher above the diversion. A redd located less than 100 m downstream of the snorkel site may have for the higher number of age 0 steelhead below the diversion, particularly in the June survey, before fry had a chance to disperse. In 2005, no age 0 steelhead parr were observed in this reach. Large beaver dam complexes below the confluence of the North and South Fork of Simcoe Creek would likely prevent upstream movement of any fry into our study reach at the low flows occurring in 2005. The absence of Age 0 *O. mykiss* in 2005 from our snorkel survey observations suggests that anadromous steelhead are the dominant component of the *O. mykiss* population in this portion of the Simcoe Creek watershed. Age 0 *O. mykiss* were present in 2006 in densities comparable to those observed at our Toppenish Creek site. In 2007 densities of age 0 steelhead were lower at both sites but comparable to the densities seen at our Toppenish Creek study site.

There was no noticeable difference in densities of Age 1+ steelhead parr between the site located upstream from the diversion and the segment located downstream from the diversion (Table 5.) Densities of Age 1+ age classes of steelhead were substantially lower in 2006 than in 2005. This is probably due to a low (undetectable) 2005 Age 0 year class in this portion of Simcoe Creek. They appeared to rebound in 2007 because of the stronger 2006 year class compared to the week 2005.

Satus Creek Tributaries

We conducted snorkel surveys at two locations on Dry Creek and one location on Logy Creek, both tributaries of Satus Creek. The purpose of these surveys was to identify rearing areas and compare Logy Creek which has an abundant supply of cool water during the summer to Dry Creek, which typically has critical low flows. The site on Logy Creek was established at RM. One site on Dry Creek (Elbow Crossing; RM 18) was situated near our Logy Creek site within 4 miles of where Dry Creek typically goes subsurface during the summer months. The second site on Dry Creek was located less than 1 mile from where Dry Creek regains continuous surface flow near the mouth of Dry Creek (HWY 97 crossing).

We established 200-meter snorkel segments at each site. Six widths from the wetted edge were measured along each segment and used to calculate the area and corresponding steelhead densities. Surveyors moved in an upstream direction from the bottom of a survey segment to the top. One person followed behind to record data. All Three sites were surveyed of 8/10/2007.

The highest density of age 0 steelhead (11.84 sthd/100m^2) was observed at the Dry Creek site near the Elbow Crossing. The highest density of Age 1+ steelhead was observed at this site as well. The lowest density of Age 0 and Age 1 + steelhead was seen at the Logy Creek site. The Dry Creek site below 97 had relatively high numbers of juvenile steelhead considering its lower elevation low summer flows. Although continuous water temperature measurements at this location indicate that water temperatures remain within a suitable range for rearing steelhead. Steelhead juveniles were also observed in other intermittent reaches of dry creek including isolated pools through early autumn 2007. Logy creek may have better rearing areas than the one sampled in 2007. We hope to expand the number of sites in both Dry and Logy Creeks in 2008.

Table 6. Snorkel survey rainbow/steelhead (*O. mykiss*) numbers and densities at Dry and Logy Creeks **2007**.

2007	Age 0	Age 0	Age 0	Age 1 +	Age 1 +	Age 1 +
Number	Dry Creek at the Elbow Crossing (200m)	Dry Creek below HWY 97 (200m)	Logy Creek at upper crossing (200m)	Dry Creek at the Elbow Crossing (200m)	Dry Creek below HWY 97 (200m)	Logy Creek at upper crossing (200m)
Nunber	129	121	45	49	30	15
Density	11.84	9.92	2.62	4.50	2.46	0.87

C. Stream Temperature

Ahtanum Creek

In 2007, we deployed nine Stowaway data loggers in the Ahtanum Creek watershed to assess the suitability of water temperature for salmonids including ESA listed steelhead and other cold water species. We intend to use this long term data to evaluate changes within the watershed that may affect water temperature (i.e., restoration projects, grazing practices, and timber harvest).

Temperature data loggers were placed in canisters and anchored with aircraft cable to trees, root-wads or other available permanent structures that could withstand high flow events. They were generally placed in pools or low flow channels that were less likely to dewater during the summer. We deployed the data loggers on 3/3/2007 at sites located between river mile RM 0.5 (at the USGS gage) and RM 18.9 (Downstream from the Ahtanum Irrigation District (AID) diversion). We also deployed three data loggers in the South Fork and one in the North Fork of Ahtanum Creek near their confluence. The units were in place and continuously recording water temperatures at 48 minute intervals until we retrieved them on 10/08/2007. Several units were lost during high discharge that occurred in May. The other eight data loggers recorded temperatures for the entire period.

Table 7. Descriptive statistics for water temperatures at 8 locations in the Ahtanum Creek watershed. Maximum Weekly Average Temperature in Bold.

Location (river mile in parenthesis)	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	Maximum 7-Day Maximum	**Maximum 7-Day Average**
South Fork Ahtanum at the DNR gate	12.0 ºC	3.1 ºC	8.8 ºC	7.4 ºC	6.2 ºC	10.3 ºC	11.5 ºC	**9.8 ºC**
South Fork Ahtnaum at campground	16.9 ºC	2.0 ºC	11.5 ºC	9.0 ºC	7.1 ºC	14.1 ºC	16.2 ºC	**13.6 ºC**
South Fork of the Ahtanum (0.5)	22.1 ºC	0.8 ºC	13.7 ºC	10.6 ºC	8.0 ºC	18.2 ºC	21.6 ºC	**17.6 ºC**
North Fork of the Ahtanum (1.3)	22.6 ºC	0.4 ºC	13.3 ºC	10.5 ºC	8.0 ºC	19.1 ºC	21.8 ºC	**18.3 ºC**
AID Diversion (18.9)	25.1 ºC	0.9 ºC	15.7 ºC	12.2 ºC	9.2 ºC	20.3 ºC	24.6 ºC	**19.8 ºC**
American Fruit Rd. (14)	25.0 ºC	1.5 ºC	15.5 ºC	12.8 ºC	10.3 ºC	20.9 ºC	24.2 ºC	**20.2 ºC**
42nd Ave. (7.0)	26.6 ºC	2.4 ºC	16.1 ºC	13.7 ºC	11.5 ºC	22.2 ºC	26.0 ºC	**21.6 ºC**
Ahtanum at the Mouth (0.5)	23.7 ºC	3.4 ºC	15.7 ºC	14.3 ºC	13.0 ºC	22.1 ºC	22.7 ºC	**21.5 ºC**

Mean daily averages ranged from 7.4ºC in the South Fork of Ahtanum Creek above the confluences to 13.7 ºC at 42nd Ave. (Table 7.) The highest instantaneous maximum of 26.6 ºC was recorded at 42nd Ave. (RM 7). The lowest instantaneous maximum for the mainstem Ahtanum was recorded at the mouth (24.1ºC). The site at American Fruit Road displayed the lowest water temperatures in 2005 and 2006. Low flows occurred at the sites below the diversions in early July affecting the water temperature.

We utilized the Maximum Weekly Maximum Temperature (MWMTs; moving 7-day average of the daily maximum water temperature) as an index to evaluate the suitability for salmonid use. MWMTs were lowest at sites at the two forks of the Ahtanum as expected because they are farthest upstream. Water temperatures gradually increase downstream on the mainstem until peaking upstream at 42nd Ave. The highest MWMT (26.0ºC) was recorded at 42nd Ave. Water temperatures improve slightly several miles downstream at the USGS gage (MWMT: 22.7ºC) where the stream is well shaded and receives groundwater recharge.

<u>Toppenish Creek</u>

We used Onset Temperature data loggers to evaluate suitability of stream reaches for salmonids including ESA listed Steelhead trout. Most units were placed in the lower reaches of Toppenish and Simcoe Creeks where flows are heavily influenced by irrigated farm and range land through water withdrawals and return flow from the Wapato Irrigation Project (WIP) diversion from the Yakima River.

Table 8. Descriptive statistics for water temperatures at 11 locations in the mainstem Toppenish Creek. Maximum Weekly Average Temperature in bold text.

Location (river mile in parenthesis)	**Instantaneous Maximum**	**Instantaneous Minimum**	**Mean Daily Maximum**	**Mean Daily Average**	**Mean Daily Minimum**	**Maximum Daily Average**	**Maximum 7-Day Maximum**	**Maximum 7-Day Average**
Topp. at N. Fork confluence (54.4)	Went dry							
Topp. at swim hole (46.8)	22.1 ºC	4.0 ºC	15.1 ºC	13.5 ºC	12.1 ºC	19.8 ºC	21.5 ºC	**19.2 ºC**
1 mile below swim hole (45.9)	23.6 ºC	4.6 ºC	17.0 ºC	14.7 ºC	12.8 ºC	20.6 ºC	22.9 ºC	**20.0 ºC**
1 mile above lateral (45)	23.4 ºC	4.4 ºC	16.9 ºC	14.6 ºC	12.7 ºC	20.7 ºC	22.8 ºC	**20.1 ºC**
Topp. above lateral (44.2)	23.8 ºC	4.2 ºC	16.6 ºC	14.4 ºC	12.6 ºC	20.9 ºC	23.2 ºC	**20.3 ºC**
Topp. below lateral (44.1)	23.9 ºC	4.1 ºC	16.7 ºC	14.4 ºC	12.5 ºC	21.0 ºC	23.3 ºC	**20.4 ºC**
0.5 mile below lateral (43.6)	Lost							
Above three way (42.8)	24.3 ºC	4.6 ºC	17.6 ºC	14.9 ºC	12.9 ºC	21.1 ºC	23.9 ºC	**20.6 ºC**
At three way (41.8)	24.9 ºC	4.3 ºC	17.7 ºC	14.8 ºC	12.6 ºC	21.2 ºC	24.6 ºC	**20.7 ºC**
Topp. At cleparty diversion (41.5)	25.9 ºC	3.2 ºC	17.0 ºC	13.9 ºC	11.7 ºC	21.5 ºC	25.3 ºC	**21.1 ºC**
Topp. above Mud Lake Drain (31.5)	Lost or stolen							
Topp. below Mud Lake Drain (31.4)	33.3 ºC	6.5 ºC	19.4 ºC	17.3 ºC	15.2 ºC	23.2 ºC	25.6 ºC	**22.0 ºC**
Topp. at Unit 2 (26.5)	Lost or stolen							
Topp. at Lateral C (21.3)	25.4 ºC	10.5 ºC	19.2 ºC	18.2 ºC	17.2 ºC	23.8 ºC	25.1 ºC	**23.6 ºC**
Topp. below Hwy97 (10.7)	24.7 ºC	9.8 ºC	18.3 ºC	17.5 ºC	16.6 ºC	23.5 ºC	23.4 ºC	**22.5 ºC**
Mill Creek	17.4 ºC	3.3 ºC	12.2 ºC	10.9 ºC	9.9 ºC	15.8 ºC	16.8 ºC	**15.2 ºC**

Temperature data loggers were placed in canisters and anchored with aircraft cable to trees, root-wads or other available permanent structures that could withstand high flow events. They were generally placed in pools or low flow channels that were less likely to dewater during the summer. We deployed 14 data loggers in the mainstem of Toppenish Creek during spring at sites located between RM (river mile) 10.7 and 55.4. We also deployed seven data loggers in Simcoe Creek, one in Mill Creek, and two in Agency Creek. The units were in place and continuously recording water temperatures at 48 minute intervals until we retrieved them on 10/09/2007. Several units failed to record temperatures and several had battery failure. Two data loggers were lost due to high flows or beaver activity. The other data loggers recorded temperatures for the entire period. We used the Maximum Weekly Average Temperature (MWAT, moving 7-day average of the daily mean water temperature) and the Maximum Weekly Maximum Temperature as an index to evaluate suitability for salmonid use.

Mean daily average temperatures in the mainstem Toppenish Creek ranged from 19.2ºC at the swim hole at RM 46 to 18.2ºC at Lateral C (RM 21.3). The highest instantaneous maximum of 33.3 occurred at the Mudd Lake Drain site on July 25th. The thermograph canister at this location was adequately submerged by about 0.8 feet of water when retrieved in October. One explanation for this spike in water temperature could be a short period dewatering caused by reduced return flow from Marion drain as changes in diversion or irrigation patterns were occurring. Other less likely explanations could be a warm effluent discharge into Marion drain or human tampering.

MWATs increased from the mouth upstream (Table 9.) All sites in the irrigated reaches of the mainstem of Toppenish Creek had MWATs above 20 degrees C and MWMTs above 25 with the exception of the downstream site below HWY 97 in the refuge where the MWMT was 22.5ºC. The highest MWMT was at Mud lake drain this year. Sections of the creek dewatered downstream from Wesley Rd as they normally do during the summer. However, only several short 100 to 200 meter reaches went dry in 2007 as water withdrawals from the lateral diversion were curtailed. Downstream from the dewatered section starting at Wesley Rd., to the mouth, conditions are considered unfavorable overall for steelhead rearing during the summer due to the high water temperatures. However, areas of upwelling from Pom Pom Rd (RM 38.9) downstream to Shaker Church Rd (RM 35.9) could provide thermal refuge for rearing steelhead parr.

We deployed four thermographs in a section of Toppenish Creek where a large restoration project to raise the stream channel and direct flow into several side- channels was completed in 2006 (Figure 3). We expect this project to increase shallow groundwater storage and flow and in turn thermal refuges where this cooler water returns to the main channel. Several impoundments were also created by this project where water temperatures were expected to increase. An overall greater variability in water temperatures in this section of Toppenish Creek is likely. Higher groundwater levels is expected to eventually increase vegetation and with it stream channel shading which should have a positive influence on water temperatures. The results from this temperature analysis indicate an increase in temperature downstream to Campbell Road. Flow increases and temperature decreases further downstream at the refuge below HWY

97 (Table 9.) The emergence of cooler groundwater could explain this decrease in water temperature. A more comprehensive temperature study will be conducted next summer

Table 9. Descriptive statistics for water temperatures at 6 locations near the Mid Toppenish Project on Toppenish Creek between August 16th and October 16th, 2007. Maximum Weekly Average Temperature in bold text.

	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	Maximum 7-Day Maximum	**Maximum 7-Day Average**
Lateral C	22.8 ºC	10.5 ºC	16.8 ºC	15.9 ºC	15.1 ºC	21.3 ºC	20.7 ºC	**19.5 ºC**
Zimmermans	22.9 ºC	9.9 ºC	17.5 ºC	16.0 ºC	14.7 ºC	21.1 ºC	21.7 ºC	**20.0 ºC**
Above sediment pond	Lost							
M. channel at campbell	23.7 ºC	9.8 ºC	17.9 ºC	16.6 ºC	15.1 ºC	22.2 ºC	22.9 ºC	**20.9 ºC**
S. channel at campbell	23.5 ºC	10.1 ºC	17.0 ºC	16.2 ºC	15.4 ºC	22.0 ºC	21.8 ºC	**20.4 ºC**
Below HWY 97	21.2 ºC	9.8 ºC	16.3 ºC	15.5 ºC	14.7 ºC	20.4 ºC	19.8 ºC	**18.9 ºC**

In 2007, we focused our efforts on the Toppenish Creek section near the Lateral Diversion at RM 44.2. Thermographs were placed every 0.5 to 1.0 miles apart from the water hole (swim hole; RM 46.8) before Toppenish Creek emerges from the canyon downstream to Wesley Road (Cleparty diversion; RM 41.5). The lateral intake is near the half-way point. Water temperatures (MWAT) increased during the first mile by 0.8 degrees. After that point, increases of < 0.2 degrees were observed at following stations until the three-way location (RM 41.9). The MWAT increased substantially (+0.8 degrees C) in the ¼ mile downstream from the three-way to the next station (Cleparty diversion; 41.5). Flows at the three-way are often measure higher than at our discharge site below the Lateral Diversion about 2.3 miles upstream. Below the three-way, surface flow decreases rapidly as it sinks into the alluvial fan. Consequently, water temperature increases in this section. The sparse vegetative cover between the three-way and Wesley Road probably contributes to the temperature increase as well (figure 2.) Withdrawals at the Lateral Diversion were lower in 2007 than in previous years (< 10% of the stream flow) during the summer months probably resulting in little impact to water temperatures.

A data-logger was placed in a pool in the intermittent reach about 1 mile below the Cleparty diversion at Wesley Road on August 1st 2007 after the warmest part of 2007. The maximum temperature recorded at this location was 23. 2ºC (MWMT 22.6ºC). Juvenile steelhead were present in this pool through-out the summer and appeared to survive the warmer temperatures by seeking refugia. Water temperatures in some locations in the section between Signal Peak Rd (RM 40.2) and Wesley Rd (RM 41.4) varied by as much as 4 degrees on a hot July day in 2007. Water was warm where it was sinking into the substrate and cooler by several degrees where it was emerging. The pool where our data-logger was deployed was one such location.

Mill Creek has summer flows below one cfs; however, water temperatures at the second Mill Creek Canyon site remained cool through-out the summer (Inst. Max 17.4ºC). *O.*

mykiss were seen residing in the pool where the thermograph was deployed several times during the summer when the unit was checked.

Figure 2 . Toppenish Creek below the three way where flow often goes subsurface during the summer.

Table 10. Descriptive statistics for 9 water temperature data loggers in the Simcoe Creek watershed. Maximum Weekly Average Temperature in bold text.

Location (river mile in parenthesis)	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	Maximum 7-Day Maximum	**Maximum 7-Day Average**
N. Fork Simcoe (24.9)	Failed							
Simcoe below Forks (18.9)	19.5 ºC	3.4 ºC	13.7 ºC	12.3 ºC	10.8 ºC	18.3 ºC	18.9 ºC	**17.6 ºC**
Simcoe at Simcoe Cr. Rd. (15.3)	Failed							
Simcoe at towtnuk Rd. (12.7)	Lost or stolen							
Above N White Swan Rd. (8.1)	Lost or stolen							
Below N White Swan Rd. (8.1)	Failed							
Barkes Rd (2.7)	24.0 ºC	3.6 ºC	15.9 ºC	14.5 ºC	13.0 ºC	22.0 ºC	22.8 ºC	**20.9 ºC**
Agency at Wesley Rd	16.4 ºC	7.5 ºC	14.0 ºC	11.9 ºC	10.3 ºC	14.3 ºC	16.2 ºC	**13.5 ºC**
Agency below falls	20.4 ºC	2.2 ºC	13.1 ºC	11.4 ºC	9.6 ºC	18.8 ºC	19.5 ºC	**17.9 ºC**

An unusual number of Simcoe Creek thermographs were lost, stolen, or failed to download data in 2007. Only two out of seven of our mainstem Simcoe Creek thermographs recorded data properly. Mean daily average water temperatures in Simcoe Creek were generally lower than the mainstem of Toppenish Creek (Table 10) ranging from 12.3ºC at the confluences of the North and South Forks at RM 18.9 to 13.5ºC at Barkes Rd (RM 2.7). Temperatures in Simcoe Creek were relatively higher than 2006 when flows were higher. Agency Creek at Wesley Rd. was cool with stable flow through out the summer produced by large springs upstream from our site.

Like the mainstem Toppenish creek, MWATs in Simcoe Creek generally decreased from the mouth upstream. Little flow exists in Simcoe Creek between Towtnuk Road and Wesley Road during the summer. Flow resumes downstream where the cooler water of Agency Creek and several springs enter. This reach along the toe of the Toppenish Creek alluvial fan between the Agency Creek confluence (RM 9.5) and N. White Swan Rd. (RM 8.1) is adequately shaded and numerous beaver dams are present.

Satus Creek

In 2007, we deployed 21 Onset Stowaway and Temp Pro data loggers in the Satus Creek watershed to assess the suitability of water temperature for salmonids including ESA listed steelhead and other cold water biota. Yakama Nation Fisheries have monitored water temperature in the Satus Creek basin since 1996. We intend to use this long term data to evaluate changes within the watershed that may affect water temperature (i.e., restoration projects, grazing practices, and timber harvest).

Table 11. Descriptive statistics for water temperature at 10 locations in the Satus Creek watershed. Maximum weekly average temperature in bold text.

Location	Instantaneous Maximum	Instantaneous Minimum	Mean Daily Maximum	Mean Daily Average	Mean Daily Minimum	Maximum Daily Average	Maximum 7-Day Maximum	**Maximum 7-Day Average**
N. Satus Rd. (1.2) *deployed on 7/11/07	23.0 ºC	11.5 ºC	18.9 ºC	17.6 ºC	16.3 ºC	21.0 ºC	22.3 ºC	20.5 ºC
Plank Rd (7.4)	26.4 ºC	2.2 ºC	17.5 ºC	15.3 ºC	13.3 ºC	24.3 ºC	25.9 ºC	23.2 ºC
Below Dry Creek (18.7)	25.8 ºC	2.0 ºC	17.2 ºC	14.3 ºC	11.8 ºC	21.8 ºC	24.9 ºC	21.0 ºC
1st Crossing (20.2)	Thermograph failed							
Above Logy (23.6)	23.4 ºC	2.1 ºC	15.7 ºC	13.5 ºC	11.6 ºC	20.2 ºC	22.9 ºC	19.7 ºC
High Bridge (32.4)	24.8 ºC	0.9 ºC	15.6 ºC	13.1 ºC	10.9 ºC	21.5 ºC	24.0 ºC	20.8 ºC
4th Crossing (34.1)	23.7 ºC	0.9 ºC	14.9 ºC	12.6 ºC	10.5 ºC	21.2 ºC	22.9 ºC	20.5 ºC
County Line (37)	Went dry							
Wilson Charley (39.2)	23.4 ºC	1.1 ºC	13.9 ºC	10.8 ºC	8.4 ºC	18.7 ºC	22.7 ºC	18.0 ºC

Wooden bridge (40.8)	21.8 ºC	2.4 ºC	13.8 ºC	11.1 ºC	8.8 ºC	17.8 ºC	21.1 ºC	17.2 ºC
Falls (44)	17.4 ºC	2.3 ºC	11.0 ºC	9.2 ºC	7.6 ºC	14.9 ºC	16.8 ºC	14.2 ºC
Logy Mouth (0.5)	23.6 ºC	1.0 ºC	14.6 ºC	12.9 ºC	11.2 ºC	21.4 ºC	22.5 ºC	20.4 ºC
Dry Mouth (1.2)	21.4 ºC	2.2 ºC	16.2 ºC	13.6 ºC	11.5 ºC	18.6 ºC	21.2 ºC	18.0 ºC
Dry at Elbow Crossing (18.5)	20.9 ºC	5.3 ºC	16.3 ºC	14.0 ºC	12.4 ºC	17.9 ºC	20.6 ºC	17.7 ºC
Kusshi Creek	Went dry by July 1							
Wilson Charley Creek	Went dry by June 20							

Temperature data loggers were placed in canisters and anchored with aircraft cable to trees, root-wads or other available permanent structures that could withstand high flow events. They were generally placed in low flow channels that were less likely to dewater during the summer. We deployed the data loggers on 3/01/2007 at sites located between river mile RM 1 and RM 44 (downstream from the falls). We also deployed a data logger in Kusshi Creek, Wilson Charley Creek, Dry Creek, and Logy Creek near their confluence with Satus Creek. The units were in place and continuously recording water temperatures at 48 minute intervals until we retrieved them on 10/09/2007. The units placed in Wilson Charley Creek and Kusshi Creek recorded temperatures until they went dry in late July and August. The other data loggers recorded temperatures for the entire period. The data from one of the loggers at 1st crossing was corrupt.

Mean daily averages in Satus Creek ranged from 9.2ºC downstream from falls (RM 44) to 15.2ºC near the mouth (Table 10). The instantaneous maximum of 26.4ºC occurred at the Plank Road crossing. The maximum 7-day average of the daily maximum (MWMT) and average (MWAT) water temperature were used as an index to evaluate suitability for salmonids and other cold water biota along the course of the stream. The thermal maximum of 24.1º C was exceeded by MWAT at several sites from High Bridge at RM 34 to the Plank Road crossing at RM 7.4 (Table 11.) MWATs ranged from 14.2º C at the falls to 23.2º C at the Plank Road crossing. During the summer there are several reaches that dewater followed by areas of upwelling. These upwelling areas, as well as springs and tributary confluences (i.e., Dry Creek and Logy Creek) provide important rearing habitat for steelhead.

Five thermographs were place in the upper Dry and Logy Creek watersheds. Water temperatures in these head waters remain cool (< 15º C) through the summer due to abundant spring water in

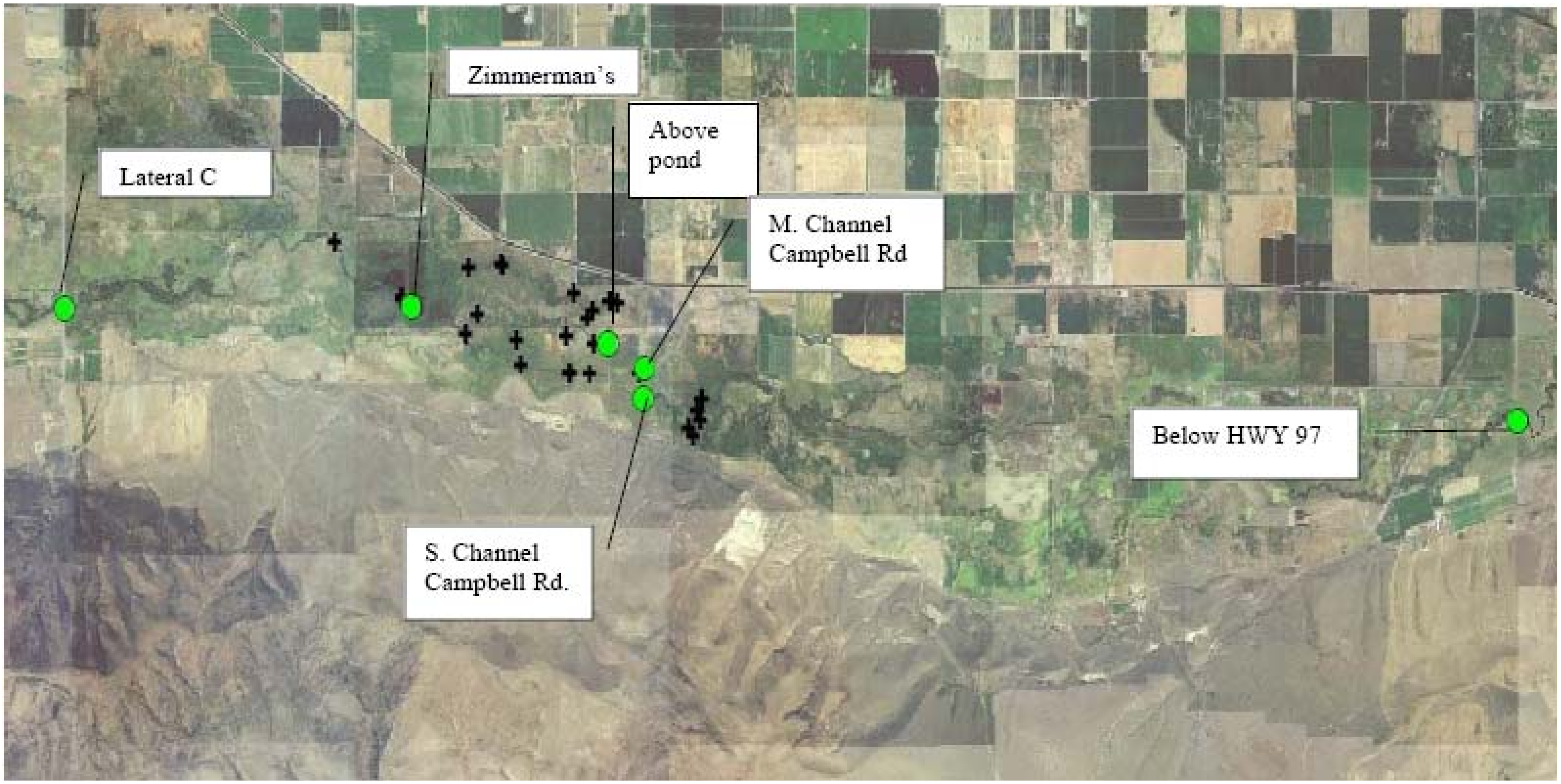

Figure 3. Location of temperature dataloggers in the Mid-Toppenish Reach. Green circles are thermograph locations. Black Xs Are grade control structures.

D. Spawning Surveys

Steelhead

Steelhead spawner surveys were performed on Ahtanum, Toppenish, and Satus Creeks. Spawner surveys are often used as an index of spawning escapement. Three passes between mid March and the end of May are optimal; however, manpower constraints, access, and survey conditions (i.e. turbidity, discharge) often limit the number of successful passes, particularly in Ahtanum and Toppenish Creeks. Two surveyors typically cover each 2 to 6 miles survey reach, walking in a downstream direction. Surveyors wear polarized glasses to aid in spotting redds. Each identified red is marked with a GPS with an accuracy of +/- 30 feet. Redds are flagged to prevent counting redds identified on previous passes. Each redd is measured and its location in relation to the stream bank and thawlweg are recorded. It is unlikely that resident rainbow trout redds (or redds from other redd building species) are mistaken for anadromous steelhead redds because of the small size of all non-adult steelhead O. mykiss observed in these watersheds during population surveys (i.e. redd counts, snorkel surveys). The number of live steelhead adults and carcasses are also recorded. When possible the sex of live steelhead and carcasses is noted. Surveyors take care not to disturb spawning fish or possible staging pools when conducting spawner surveys.

<u>Toppenish Creek</u>

The Toppenish Creek watershed includes nearly 100 miles of anadromous fish bearing stream habitat. We cover 78 miles of these waterways during our annual redd counts. Like Ahtanum Creek, a long protracted snowmelt flood pulse often causes unfavorable survey conditions for several weeks in March and April. In addition, the forest roadways in the upper Toppenish Creek watershed are typically not cleared of snow unless on an active logging unit or a major arterial road.

In years with normal or above normal snowpack in the headwaters, the upper 18 miles of surveyable steelhead spawning habitat are typically inaccessible until the beginning of May or later. In 2007 on the upper Toppenish mainstem and the North fork of Toppenish, the first pass was completed on 5/16/07. Additional passes of the upper watershed were not completed because redd conditions indicated that the bulk of spawning activity was probably over. Road conditions rarely inhibit access to Simcoe Creek and its tributaries because much of the watershed is located in the valley, although high flows sometimes cause unfavorable conditions. On the lower 18 miles of habitat on Toppenish Creek access can be limited by high flows that can exceed 200 cfs for several weeks making spawning surveys dangerous. In 2007, we managed to complete two passes on the lower portion of spawning habitat.

We identified more redds in 2007 (42) than we found in 2006 (21)(Table 12.) Survey effort and conditions in 2007 were similar to 2006, although the upper portion of Toppenish Creek where the best steelhead habitat is located was not accessible in 2006 until later in the season. This may have accounted for the difference in number of redds identified.   Only two redds were identified in the upper Toppenish Creek in 2006 compared to 14 seen in 2007. In 2005, when access and visibility conditions were optimal due to drought conditions and a meager snowpack 60 percent of redds in the Toppenish Creek watershed were found in the upper 18 miles of Toppenish Creek.

Table 12. Number of Steelhead redds per reach in the Toppenish Creek watershed in 2007.

	Upper Toppenish Watershed			
Toppenish	O Conner Creek (65.7)	East Bank (62.4)	3	7
	East Bank (62.4)	NF confluence (55.4)	7	5
	NF confluence (55.4)	Wash out (53.5)	4.5	1
	Wash out (53.5)	Wiley Dick (48.5)	5	5
	Wiley Dick (48.5)	Olney Lateral (44.2)	4.9	4
	Olney Lateral (44.2)	Marion Drain Rd. (38)	4.2	2
	Marion Drain Rd. (38)	Shaker Church Rd. (35.9)	4	0
total			29.5	**25**
N. Fork Toppenish	NF Falls (4)	NF confluence (0)	4	**1**
Willey Dick	old logging site (4)	Confluence (0)	4	**0**
	Simcoe Creek Watershed			
Simcoe	NF at 2nd crossing (6.5)	Diamond Dick (3.4)	3.1	1
	NF at Diamond Dick (3.4)	NF/SF confluence (0)	3.4	3
	SF 6 mile above confluence (6.2)	3 mile above confluence (3)	3.2	1
	SF 3 mile above confluence (3)	NF/SF confluence (0)	3	0
	NF/SF confluence (18.9)	Simcoe Creek Rd. (15.3)	3.6	4
	Simcoe Creek Rd. (15.3)	Towtnuk Rd. (12.7)	3.1	4
	Towtnuk Rd. (12.7)	N. White Swan Rd. (8.1)	2.8	1
	N. White Swan Rd. (8.1)	Stephenson Rd. (5.9)	2.3	0
total			24.5	**14**
Agency	Falls (8.9)	Western Diversion. (4.4)	4.5	2
	Western Diversion. (4.4)	Confluence (0)	4.4	1
total			8.9	**3**
Wahtum	Yesmowit Rd. (3.6)	Confluence (0)	3.6	**0**
Total			77.6	**42**

The Simcoe Creek subwatershed is better suited to multi-year comparison of spawning escapement compared to the mainstem Toppenish for several reasons including 1) lower peak flows, 2) early spring access 3) lower turbidity during spring thaw. Three passes in the Simcoe watershed were possible in 2007, however only 2 were completed due to a manpower shortage. Seventeen redds were identified in the Simcoe Creek watershed in 2007 compared to 10 in 2006. The distribution of redds throughout the Simcoe Creek watershed was similar to that of 2006. Redds were observed near the upper limits of the North Fork of Simcoe Creek, South Fork of Simcoe Creek, and Agency Creek. This contrasts with the 2005 season where obstructions and low flows blocked passage of adult steelhead above the narrows (RM 12.5) and all 9 redds were located below that area where habitat and summer water temperatures are less optimal.

Satus Creek

Compared to other watersheds in the Yakima River Basin the conditions are most favorable and consistent in the Satus for conducting steelhead spawning surveys from season to season. This is mostly due to its lower elevation and limited snowpack. The survey conditions in the Satus watershed also recover quickly (i.e. several days) from periods of high runoff – unlike the Toppenish and Ahtanum watersheds which can be unwalkable for weeks at a time. Due to runoff patterns in the Satus Creek watershed, staff are typically able to complete all three passes on the mainstem of Satus Creek, Dry Creek, and Logy Creek. In 2007, like most years only one pass could be completed on Mule Dry, Wilson Charley, and Kusshi Creek before low flows make fish passage unlikely.

Eighty-seven steelhead redds were identified in the Satus Creek watershed in 2007 compared to 60 in 2006 (Table 13.) It is likely that these counts reflect an increase in steelhead spawning activity in the Satus watershed in 2007 over 2006 because conditions were similar. Although in 2006 only two passes could be conducted on Satus, Dry and Logy Creeks because of manpower constraints.

The distribution of redds within the Satus watershed was similar to what was observed in 2006. More redds were observed in the mainstem Satus, Dry and Logy Creeks in 2007. Redd numbers were similar in Wilson Charley Creek and Kusshi Creeks. No redds observed in Mule Dry Creek in 2007 because the stream was probably impassable to migrating adult steelhead for a significant portion of the season.

Ahtanum Creek

Conditions for spawning surveys were poor in 2007 because of turbidity and high flows for much of March, April and May; therefore, spawning surveys were not conducted.

Coho

Two coho salmon surveys were conducted in Ahtanum Creek during fall 2006 between the mouth and the bridge at Goodman Rd. at RM 2.8. The first survey was performed on 11/02/2007 and the 2nd was performed on 11/29/2007. A total of seven coho redds and three live adult coho were identified in Ahtanum Creek in fall 2006. Most redds were identified in Fulbright park about 0.5 miles upstream from the mouth.

Bull Trout

Bull Trout redds were surveyed in September and October 2007. Surveyors walk a 4 mile section of the South Fork of Ahtanum Creek in an upstream direction. A method developed by WDFW is employed.

A total of five redds were identified during the three passes of our survey in 2007. The first survey was conducted on 9/10/07, with 2 redds located. Two spawning adults were observed on one of the redds. During the second pass on 9/25/07 one possible redd was identified. During the third pass on 10/9/07, 2 additional redds were identified.

Table 13. Number of steelhead trout redds per reach in the Satus watershed in 2007

Stream	Start location	End location	Distance (miles)	# of Redds
SATUS	Falls (44.1)	Wood Bridge (40.8)	4.2	**4**
(3 passes)	Wood Bridge (40.8)	County Line (36.4)	4.4	**7**
	County Line (36.4)	High Bridge (32.4)	4	**10**
	High Bridge (32.4)	Holwegner(28.4)	4.8	**8**
	Holwegner (28.4)	2nd X-ing (23.7)	3.9	**5**
	2nd X-ing (23.7)	1st Xing (20.2)	3.5	**4**
	1st X-ing (20.2)	Gage (17.4)	2.8	**1**
	Gage (17.4)	Rd 23 (13.1)	4.3	**0**
total			31.9	**39**
LOGY	Falls (14)	Spring Cr (11)	3	**7**
(3 passes)	Spring Cr (11)	S. C. Ford (9.5)	1.5	**3**
	S. C. Ford (9.5)	3rd Xing (3.5)	6	**6**
	3rd Xing (3.5)	Mouth (0.0)	3.5	**4**
total			14	**20**
DRY	South Fk. (27.8)	Saddle (24)	3.6	**2**
(3 passes)	Saddle (24)	Elbow Xing (18.25)	5.75	**13**
	Elbow Xing (18.25)	Seattle Cr (14)	4.25	**3**
	Seattle Cr (14)	Rd 75 bend (8.75)	5.25	**2**
	Rd 75 bend (8.75)	Power Line Ford (2.5)	6.25	**4**
	Power Line Ford (2.5)	Mouth (0.0)	2.75	**0**
total			27.85	**24**
W. CHARLEY	Forks (1.9)	Mouth (0.0)	1.9	**1**
KUSSHI	Top (11th) Xing (5.5)	Mouth (0.0)	4.5	**3**
SHINANDO	Ford (0.5)	Mouth (0.0)	0.5	**0**
MULE DRY	Yakima Chief Rd. (11.35)	Rd. 39	11.35	**0**
TOTAL			82.05	**87**

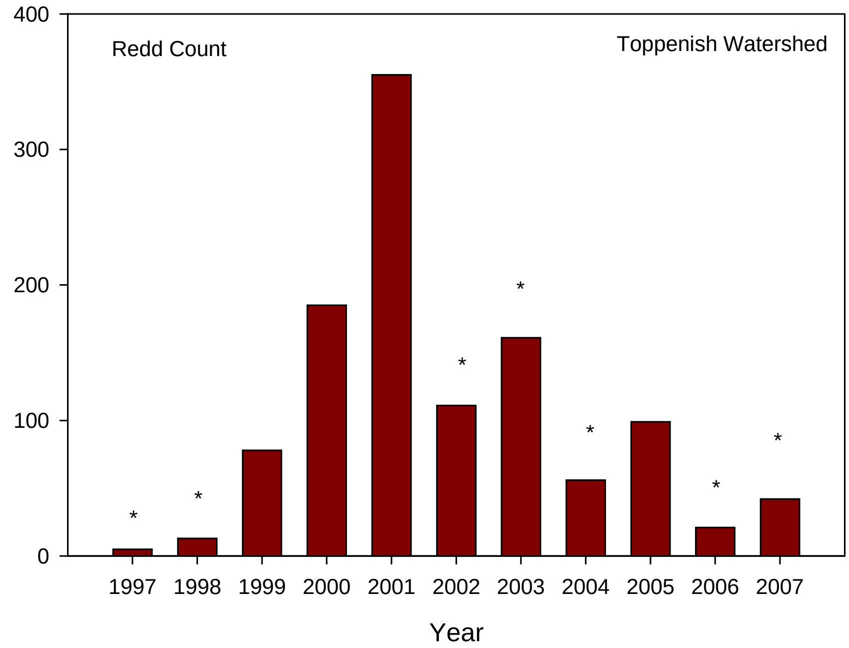

Figure 4. Number of redds in the Toppenish Creek watershed for past 10 years

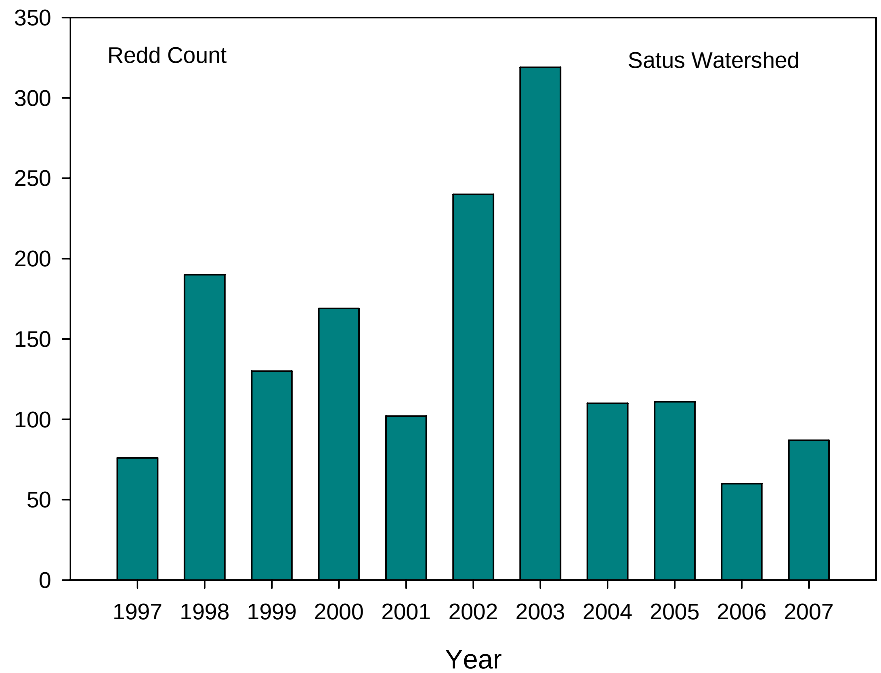

Figure 5. Number of redds in the Satus Creek watershed for the last 10 years

E. Starvation Flats Aquifer Monitoring

Eight test wells were monitored on Starvation Flats were a fencing project was completed in 2007 and restoration work is planned for 2008. Wells were measured bi-weekly starting in mid-August. Ground water levels dropped steadily through the summer and early Autumn. We attempt to continue measurements through the winter and spring.

III. Restoration Projects

A. Starvation Flats Exclosure Fence

Starvation Flats is the headwaters of North Fork Dry Creek that feeds in to Satus creek, it is located in Section 27, T9, R16E. Starvation Flats has been impacted by timber harvest, road construction and grazing. These impacts have changed the hydrology of this area causing the watercourses to incise and the water table to drop. In addition, the area is thoroughly grazed both by cattle and by wild horses, deer and elk.

In the last decade DNR staff has made numerous attempts to stabilize the severe headcuts to prevent further degradation to this area. These attempts have had mixed results, and more work is needed for a more complete restoration of the Starvation Flats area.

The Yakama people have historically used this area for root gathering and hunting. Cultural artifacts have been documented in numerous locations within this area. Through the years YRWP staff has been notified by Yakama people complaining about the cattle in the area. Cattle, horses, deer and elk have all played a role in the degradation of this sensitive area. Livestock trails have often served as vectors for runoff that which in turn erode new channels throughout the meadow area (Figure 6.)

Figure 6. Road vectoring water into incised channel

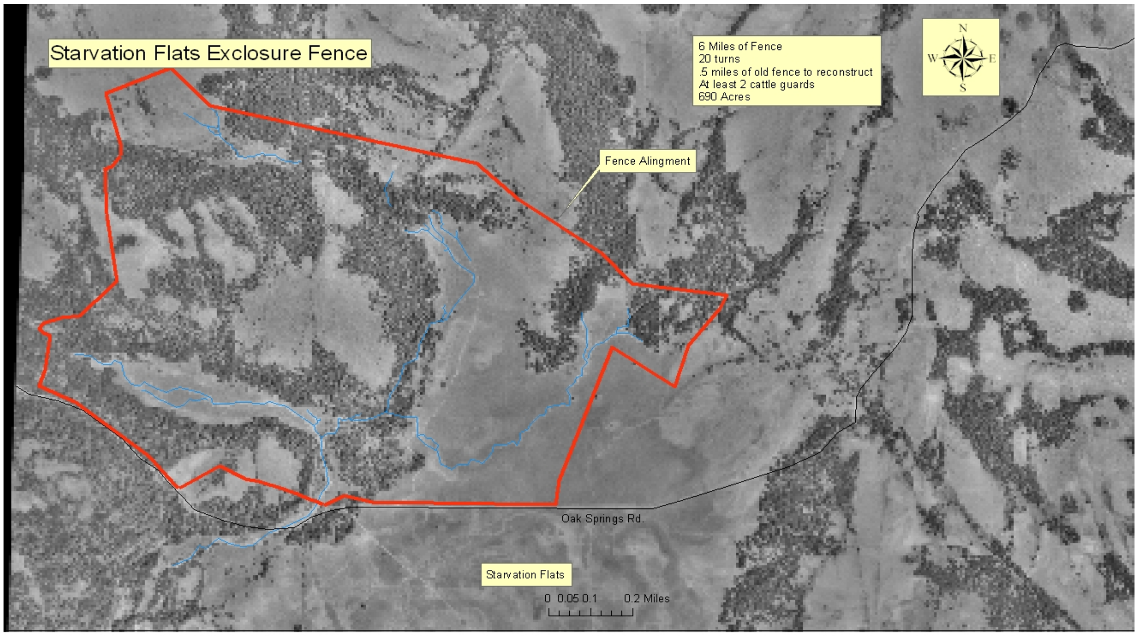

Figure 7. Map of Starvation Flats Fence and Viscinity

To help protect this area and improve the meadow hydrology YRWP staff constructed a 6 mile long grazing exclosure fence to protect a significant portion of Starvation Flats. (Figure 7.) The fence prevents cattle and horses from degrading this area and will allow the vegetation on the surrounding floodplain to become vigorous enough to withstand overland flow. Building a fence will help address the grazing problem in this complex situation. Other measures, including the construction of 8 miles of fence along Toppenish Ridge in 2005 will further help alleviate the grazing related issues.

Further work in this area will include adding large rock grade control structures to stabilize several active headcuts and move the stream back into connection with its floodplain. YRWP staff propose to address the headcuts in FY 2008 or 2009, once the vegetation has had an opportunity to become well reestablished. Our experience in other meadows tells us that 1 to 2 years is usually enough time for this to occur.

Timeline and supervision:
Construction of the fence occurred in during the summer of 2007. All work was supervised by the YRWP's field supervisor.

Fence Alignment Details:
Significant work was put into determining the best and most efficient alignment for this fence. There were three main watercourses in the vicinity of the proposed fence with a total stream length of 3.6 miles. Because our ultimate goal is to restore the hydrology (not just the vegetation) of the area inside the fence, we had to create an exclosure not only around the heavily incised areas of the channel, but the up-sloped parts of the watercourses as well. Additionally, staff took into consideration other factors such as

rare or very sensitive areas and because of this, several small wet meadows and aspen groves were included in the exclosure.

Methods:
This fence was built to National Resource Conservation Service specifications, 5 strand barbed wire, line posts every 600ft, H braces every ¼ mile, steel pipe was set in a 28"x12" block of concrete, rock jacks were constructed of galvanized field wire and pressure treated lumber. When available, barbed wire was attached to live trees using several 2x4's for spacers. Brushing of the alignment by hand tools (chainsaws) was allowed however no ground disturbance was permitted. Materials were brought to the jobsite using a pickup truck or a 6x6 ATV at remote sites. Two 12'cattle guards were installed where a secondary road enters and leaves the meadow.

Conclusions:
The YRWP has constructed several similar fences in the last few years. The exclosure fence in Rentchler's Meadow is a good example and a reasonable replicate as well. Rentchler's Meadow was similar to Starvation in that its watercourse has incised and its floodplain had been grazed excessively. YRWP staff constructed a fence in much the same manner as the one in Starvation. The results were immediate and very positive; we quickly saw an explosion of vegetation during the fist summer. The second summer we actually saw standing water persist in the meadow until late August. Previous to the exclosure fence, standing water had disappeared by late June. Because of these observations, we feel that we'll see similar results in Starvation Flats.

B. Branch Creek Culvert Removal and Armored Crossing Construction

Project Description:
Branch Creek enters the NF Toppenish Creek at RM 3.2, and drains a 23-square-mile watershed. The creek is utilized by Middle Columbia River steelhead for spawning and rearing. Branch Creek has two bottomless arch culverts that were available for removal and replacement by armored stream fords. One is located at RM 1.1 ant the other at RM 1.4. The project is located in the NW1/4, NE1/4, Township 10 North, Range 14 East, Section 1, on Tribal Trust land in the Closed Area of the Yakama Reservation.

YRWP staff proposed to remove both culverts and replace them with armored stream fords. The uppermost culvert was already a complete loss (Figure8;) the stream had completely undermined the footing, and is currently flowing outside of the culvert on the left side bank. The lower culvert is still functioning as it was intended, although the stream had undermined a small portion of the right side on the downstream end. The assistance of a professional engineer was employed during the planning phases of this project and a set of construction plans was produced by that engineer.

In addition to the fish and stream benefits, YRWP staff will use this project as an example to show Tribal and BIA road engineers how armored crossing can be constructed in place of culverts. The armored crossings are a much better choice for many stream crossings and we hope that with the success of this project, the engineering staff will begin to use them instead of culverts, where appropriate.

Figure 8. Upper culvert with exposed footings

Methods:

Work at the upper culvert site included culvert removal, excavation of excess road fill, installation of rock grade control structure to stabilize the ford and an armoring or roughening of the ford. Work at the lower culvert site included removing the culvert, excavation and removal of excess road fill, installing rock grade control to stabilize the ford and an armoring or roughening the ford.

Both culverts were removed using a 300 series tracked excavator. The culvert fill was removed until the culvert's structural bolts and concrete footing were exposed (Figure 9.) The bolts were then removed and the culvert was separated from its concrete footing with a cutting torch. The culvert was then removed in pieces in a manner that will allow it to be used again. Care was taken at all times to keep sedimentation of the stream to a minimum.

Figure 9. Lower culvert exposed by excavation

Once the culverts were removed, construction of the new road approaches began (Figure 10.) Our plan was to make the crossings passable for wildland firefighting vehicles. The existing road approaches were sloped back to create an incline that large vehicles can climb out of under a load.

Figure 10. Construction of the new crossing approach

After the approaches were set, the final task of constructing the armored ford began. 844 cubic yards 2’x3’ columnar basalt was hauled in from a quarry approximately 2 miles away. The existing streambed was excavated to a depth of approximately 2’ and the basalt was placed so that the upward facing side was flush with the surrounding stream bed grade (the ford does not impound water.) This process was repeated as per the construction plans until both fords were complete (Figure 11.)

Figure 11. New armored crossing topped with 5/8 minus crushed gravel. Armor rocks are seen on the right.

Discussion:
The Branch Creek project was completed with a minimum of problems. The construction plans were very good and the construction contractor had little trouble following them. There were two issues that came up during construction that are worth further discussion.

The first was our discovery of a small, likely ephemeral, spring (Figure 12) that had been hidden by the culvert fill. The spring was a surprise and a problem because it discharged directly onto the new road surface, making it very soft. Our solution to this problem was to excavate more of the dirt from the roadway and replace it with large rock. This allowed the spring water to infiltrate into the interstitial spaces around the large rock, below the surface grade of the road. The large rock was covered with crushed top-course rock to create a smoother finished road surface.

Figure 12. Spring that had been hidden by culvert fill (top left of photo)

The second issue we encountered had to do with the upper armored crossing. Once the crossing was completed, it became apparent that the spaces around the armor rocks were too wide, and they were allowing the surface stream flow to disconnect for about 20 ft. This had been a concern brought up during the pre construction meeting, and the contractors had been advised that the creation of “hotspots” would not be allowed. The solution was simple; a small load of crushed rock was brought to the site and mixed into the interstitial spaces around the larger rock. This forced the stream to flow over the armored crossing instead of under it.

Conclusion:
YRWP staff are confident that this project will meet its goal of allowing more proper stream function while also keeping the road open for emergency vehicles.

C. Lincoln Meadow Rock Haul

Lincoln Meadow is a montane meadow that feeds in to Toppenish Creek. It is located in Section 21, T10, R14. Lincoln Meadow has been impacted by timber harvest, road construction and grazing. These impacts have changed the hydrology of the meadow causing a drop in the water table and have allowed headcuts to migrate through the meadow incising the watercourse (also contributing to the lowering of the water table.)

In 2006, YRWP staff completed the first phase of the Lincoln Meadow Restoration Project (YRWP annual report 2006.) That project involved the construction of a grazing exclosure fence around the meadow and the relocation of a forestry road and culvert that bisected the meadow. That project was successful and in 2007, the YRWP began designing the second phase of the project which was the construction of about 16 rock grade control structures that would move the streambed into better connection with its floodplain.

In July 2007, YRWP staff produced a conceptual design for constructing the grade controls. The plan calls for 16 structures which will take about 500 cubic yards of rock. Other projects (Branch Creek and Graves Culvert Removal) took priority over this one during the summer of 2007; however we were able to haul the rock required for the project to the site, as an extension of the Branch Creek project. The sites are about 6 miles apart, and because a loader and several dump trucks were already mobilized for the Branch Creek job, it was very cost effective to haul rock to the Lincoln Meadow jobsite at the same time. The haul was completed in mid August and we anticipate moving forward with the construction of the grade control structures in July of 2008.

D. Graves Property Culvert Removal Phase I – Rock Haul

The Graves Property Culvert Project will remove a culvert located in the mid reach of Toppenish Creek. The culvert is currently a velocity barrier to upmigrating steelhead. Project staff have been working with an engineering consultant since May of 2007 in an effort to complete plans to remove the culvert and stabilize the site. Despite our greatest efforts, we were not able to complete the plans to a satisfactory level in time to begin deconstruction of the culvert in the summer of 2007.

Although we did not have plans that would allow us to move forward with the deconstruction process, we felt that the plan's rock quantities were of sufficient accuracy to warrant hauling rock to the site. The rock haul began on Sept. 17th and continued through Sept. 28th. 3000 cubic yards of rock were hauled to the project site, and are now ready for use when we begin deconstruction in July of 2008.

E. Riparian Fencing and Revegetation

YRWP staff constructed six miles of new meadow exclosure fence in 2007. New construction included the Starvation Flats meadow exclosure fence (Figure 13.)

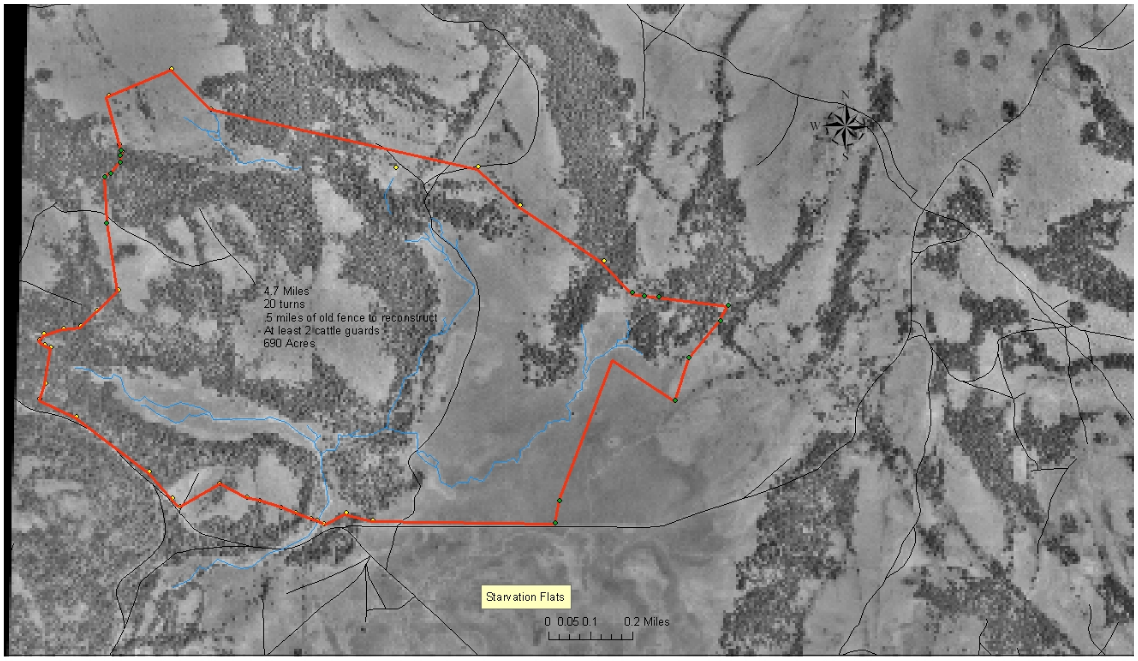

Figure 13. Map of Starvation Flats Exclosure Fence. The fence miles and acres on the map are inaccurate, as the fence was expanded during construction.

Meadow exclosure fencing is done in order to allow vegetation to re-establish. Once this has been completed, staff begin restoration of hydrologic function. This usually involves constructing grade control structures in the watercourse that drains the meadow to reestablish groundwater storage capacity and slow the rate of runoff.

IV Operations and Maintenance

A. Stock Wells

YRWP staff repair and maintain 33 solar powered stock pumps (Figure 14) and 3 stock water pipelines in the Ahtanum and Toppenish Watersheds. These pumps and pipelines are used to provide stock water when YN minimum instream flow criteria mandate the cessation of irrigation. It is necessary to have many wells because there are many individual cattle operations, several of which may not always be served by a single well. Operating these wells has been a difficult task which we are still in the process of perfecting. Project staff anticipate constructing more stock pipelines that will be associated with the existing stock pumps. This will better meet multiple users' needs while only using one stock pump.

Figure 14. Stock pump and watering trough.

Routine maintenance of these facilities includes fixing a significant amount of broken PVC plumbing (often associated with cattle damage), replacing the electrical pieces of the pump's control systems as they wear out and upgrading the water troughs associated with the pumps.

Project staff have found that most of the infrastructure associated with the watering troughs (hoses, float switches, trough supports etc.) were too lightly built. Over the last year we have been working to upgrade this infrastructure with more rugged float switches, flexible PCV hoses instead of garden-type hoses, more sturdy stanchions for the troughs and gravel aprons around the troughs to prevent soil erosion.

We have experienced relatively few problems with the solar arrays associated with the pumps. Several arrays have been upgraded to provide more power and thus more pumping capacity to units that experience high demand.

B. Fencing

Staff maintained over 158 miles of range unit boundary fence, 15 miles of riparian fence and 10.5 miles of meadow exclosure fence. The YRWP maintains range unit boundary fence in places where those fences keep cattle out of sensitive areas. Much of this maintenance focuses on the boundary fences surrounding the Logy Creek range units that are leased by the project. Staff build and maintain riparian fencing Some of the maintenance is done in cooperation with the Bureau of Indian Affairs' Range Program, however that program is chronically understaffed, and much of the work falls to the YRWP.

Project staff constructed 6 miles of new meadow exclosure fence in the Starvation Flats area. Most of the range unit fencing is located along the perimeter of the Project's leased range units. The riparian fence is distributed as follows: 8.5 mile in the Ahtanum Watershed, 2 miles in the Toppenish Watershed and 5 miles in the Satus Watershed. Maintenance of both riparian and range unit fencing is necessary because in some cases range unit fencing is actually being used to create an exclosure (cattle on the outside) of the entire range unit. This is the case with the entire Logy Creek watershed (100 sq mi), where the range unit fence prohibits any grazing. Logy Creek and its tributaries are the major source of summer flow for Satus Creek.