

Lonely Gulch Watershed Restoration Monitoring Report, 2002-2006

USDA Forest Service
Lake Tahoe Basin Management Unit



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Executive Summary

The purpose of monitoring was to evaluate the effectiveness of a restoration project to restore bank stability along a 350-foot section of Lonely Gulch Creek, located on the west shore of Lake Tahoe. Prior to this restoration implemented in 2003, the site was deemed vulnerable to large-scale stream bank erosion as stream banks caved-in from excessive tree fall of dead and dying conifer lining the banks of the creek. Restoration included removal of many of the fallen trees, placing several in the bed at grade, and keying them into the banks to provide streambed stability. In addition, sections of streambank were reshaped to a lower angle and planted with native vegetation along the channel's edge.

The Forest Service utilized four metrics to track the performance of the treatments employed during this restoration effort. The four metrics are:

1. Stream flow turbidity and suspended sediment samples as quantitative measure to track changes in the quality of water entering and exiting the site.
2. Installation of photo points with pictures taken annually as a qualitative measure of streambed and bank stability as well as riparian vegetation recovery.
3. Installation of cross-sections as a quantitative measure of streambed and bank stability.
4. A macro invertebrate inventory as a quantitative measure of stream system health (compared against other Tahoe Basin streams).

Conclusions from the monitoring data are:

1. Turbidity and SSC data stayed well within state water quality standards and did not indicate significant differences between above and below project sampling locations.
2. Photo documentation indicates that the streambed and banks are recovering and vegetation appears to be on a positive trajectory in terms of developing a riparian corridor.
3. Repeat cross-section measurements indicate some isolated lateral erosion of banks, but it is not considered excessive. Vertical adjustments are minor and appear to be a reflection of expected natural flux.
4. Macro invertebrate sampling indicates that the site is biologically healthy when compared to other Basin streams.
5. There are no visible indications that the streambed, banks, or riparian vegetation at the site responded negatively to a large mid winter flood occurring on December 31, 2005.

We conclude the project is responding as predicted and monitoring was successful at documenting this response. Of note, a gully has formed in the channel downstream of Forest Service Property. The head of this gully appears to be migrating slowly up-channel towards the restoration site. The log grade control at the downstream end of the project likely will check its migration and leave the restoration area unaffected. Nevertheless, monitoring of photo points will continue annually, and cross sections measurements repeated following any unusually large flood event, to track changes and take action if necessary.

I. INTRODUCTION

Lonely Gulch Creek is a west shore tributary draining directly into Lake Tahoe. The contributing watershed area above the project is approximately 3mi². The watershed flows originate on the eastern flank of Rubicon Peak. Steep, forested headwater channels flowing over glacial debris capped with modern alluvium feed the main stem of the creek. The project is located on Forest Service lands 250-feet downstream of a culvert crossing on Glen Drive in the Rubicon Bay Subdivision (See Figure 1). Downstream of the project the channel flows through private property for 600 feet before reaching a culvert, which conveys flows beneath California State Highway 89.

The flood flows in January 1997 undercut the root wads of numerous dead and dying conifers along on the Forest Service land bordering the creek. Subsequently, high winds over time toppled nearly all the vulnerable trees. Trees toppled with their root wads pulling away from the bank leaving 3-5' high vertical, raw, un-vegetated stream banks. Wind throw is a natural and necessary process needed to recruit wood in forested streams; however, wind throw was probably excessive given the poor condition of the forest along the banks and in that area. Excessive wind throws left bank conditions ripe for potential release of several hundred cubic yards of sediment into the stream.

In July of 2003, the Ecosystem Restoration crew implemented a restoration project with the goal of stabilizing the 350-foot reach of Lonely Gulch Creek which flows through Forest Service lands.

The specific restoration activities included:

1. Clear the channel of excessive downed wood.
2. Reshape and reduce bank angle, and revegetate channel edge.
3. Utilize heavy equipment to strategically embed and key in several logs to provide grade control.
4. Scatter available woody debris along streambanks and sideslopes to provide additional surface stabilization.

The following monitoring metrics were chosen to evaluate the success of the project:

1. Turbidity and suspended sediment and turbidity entering and exiting the restoration site, before and after restoration activity.
2. Photo documentation of any changes in stream channel morphology, as well as recovery of riparian vegetation.
3. Cross section measures of streambed and bank geometry.
4. Macro invertebrate assemblages as an indirect measure of water quality and the channel's ecological health

LONELY GULCH WATERSHED RESTORATION

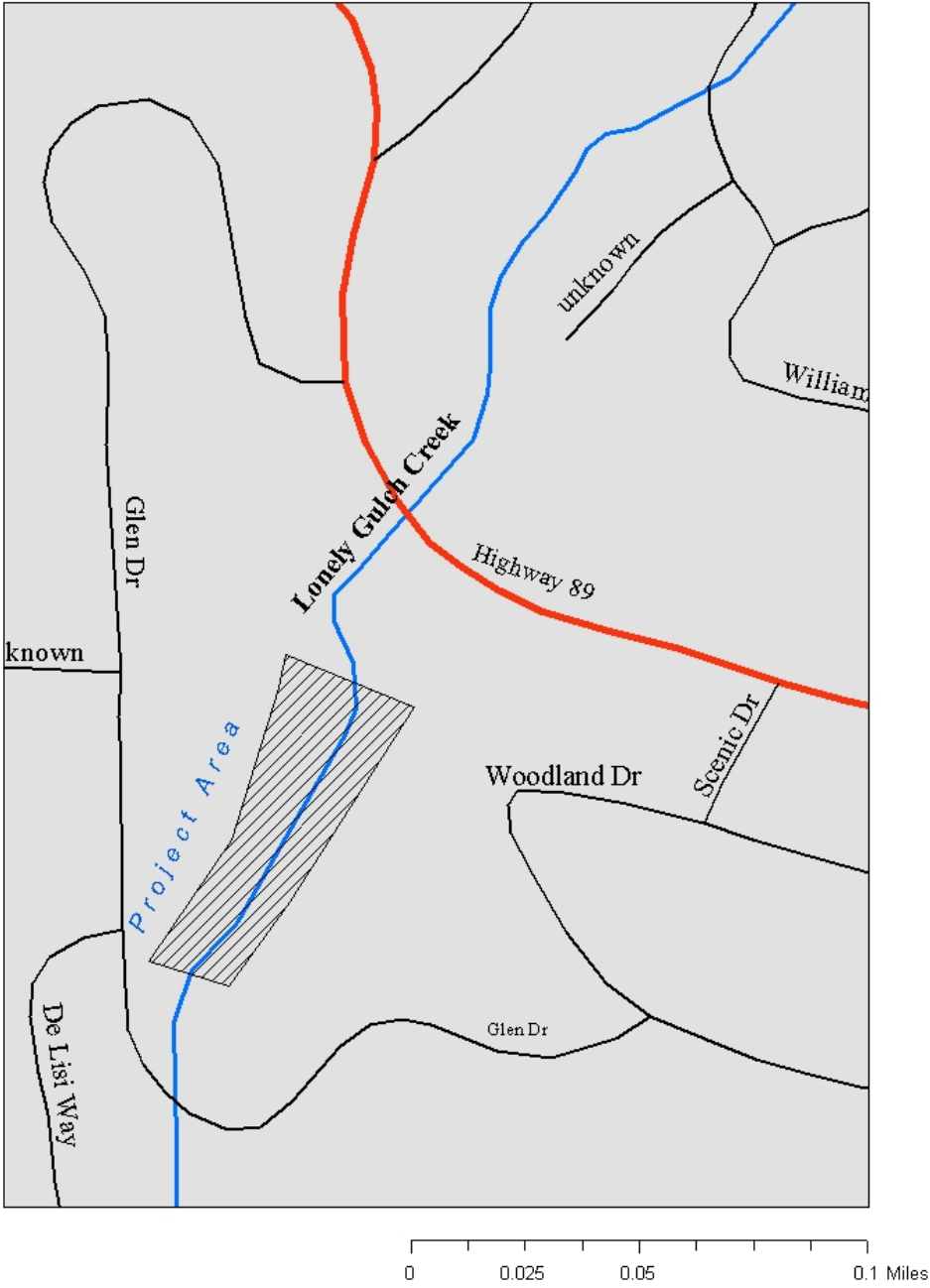


Figure 1: Lonely Gulch Restoration Project Site Map

II. METHODOLOGY

A brief description of the approach used for the monitoring metrics is described below.

- **Water Quality** – Water quality sampling was a requirement outlined in our State of California 401 water quality certification. Two sampling sites were established; an upstream site (53-1) located upstream from the project area and below a small road crossing, and a downstream site (53-2) located downstream from the project area and upstream of the Highway 89 crossing. We measured discharge (cfs), turbidity (ntu), and suspended sediment concentration (SSC) (mg/liter) at the two stations weekly during spring runoff and monthly during base flow. One year of pre-project measurements were taken in 2002, and post project measurements were obtained from 2004 through 2006.
- **Photopoints** - Photo documentation consisted of four permanent photo point monuments, located upslope of the channel, with photos taken from various angles in relationship to the monument. Photos were taken in 2002 (pre-project), and 2004 and 2006 (post-project).
- **Cross-sections** – Four channel cross sections, were established with permanent monuments at each end, in 2003 (post restoration), and resurveyed in 2004, 2005, and 2006.
- **Macro-invertebrates** – Macro-invertebrates are performance indicators used as an indirect measure of the success of restoration activities. Macro-Invertebrate sampling was conducted utilizing techniques outlined the Forest Service Region 5 Stream Condition Inventory (SCI) protocol. Samples were taken in four riffle units located in the project area immediately after restoration activities were completed, in September of 2003. The resulting multi-metric index score of species richness and abundance was compared against other Basin streams sampled in 2003.

III. RESULTS & DISCUSSION

1. Water quality

Water quality data are presented graphically in Appendix A1, and in tabular format in Appendix A2.

Discharge

The graphs presented in Appendix A1 illustrate that two of the post project water years (2005 and 2006) had much higher flows than the one pre- project 2002 water year. Turbidity concentrations at both the above and below sites generally seemed to increase with increased flow, particularly in 2005. On the other hand, suspended sediment concentrations seemed to reflect less pulsing of sediment during 2005 and 2006, when compared to the pre-project data collected in 2002.

Turbidity

Table 1 lists annual medians for turbidity data. The California state water quality standard for turbidity is no more than a 10% increase over background levels as a result of management activities. For the purpose of this comparison, background is assumed to be represented by data collected at the above project site. The data in Table 1 indicates median annual turbidity exceeded this standard in 2005, however median turbidity values measured at both sites for all years was extremely low, ranging between .25 to .86 NTUS. Statistical analysis was conducted on these data using the non-parametric Mann Whitney Rank Sum test. This test determined that the difference between above and below sites was not great enough to exclude the possibility that the difference is due to random sampling variability, therefore the differences are not considered to be statistically significant. This result was the same for all sample years.

Table 1: Median Annual Turbidity (NTU) at Lonely Gulch Creek

Turbidity	2002	2004	2005	2006
Above	.25	.56	.56	.35
Below	.28	.47	.86	.32
Difference	.02	-.09	.30	-.03
% Difference	8%	-16%	54%	9%

Suspended Sediment

Table 2 illustrates annual medians for suspended sediment data. The California state water quality standard for suspended sediment is no exceedance of 60 mg/l at the 90th percentile. The raw data in Appendix A-2 illustrate that this standard was easily achieved at both sites for all years for suspended sediment values. The highest individual daily value recorded was on 6/17/03 with 27.9 mg/l and 21.6 mg/l recorded respectively at the above and below sites. Statistical analysis again determined the observed differences in medians were not statistically significant.

Table 1: Median Annual Suspended Sediment (mg/l) at Lonely Gulch Creek

Suspended Sed.	2002	2004	2005	2006
Above	1.2	1.3	1.0	.7
Below	1.0	1.4	1.0	.7
Difference	.2	.1	0	0
% Difference	16%	5%	0	0

2. Photopoints

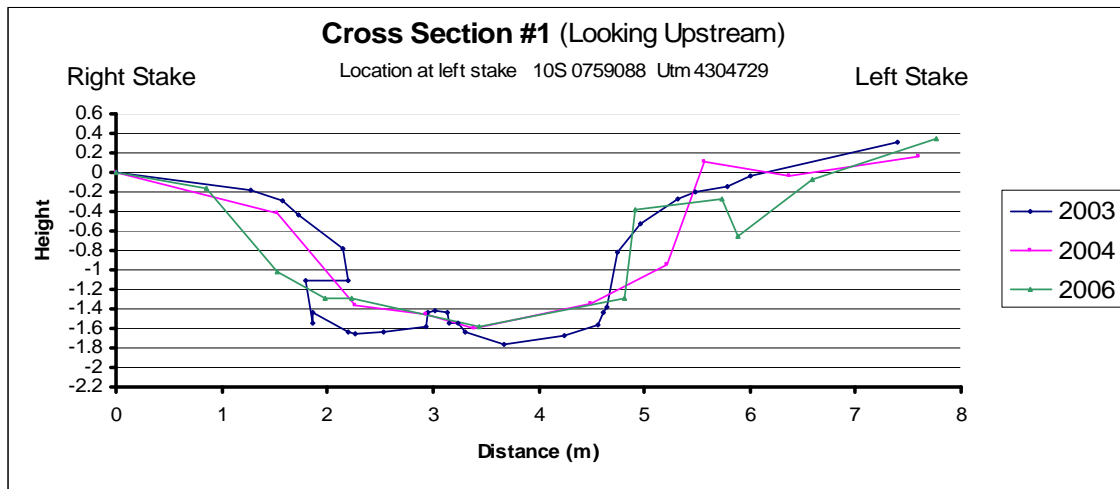
The photopoints, presented in Appendix B, illustrate that stream morphology is responding as expected. Reducing bank angles has resulted in the formation of a characteristically narrow riparian zone, lateral and vertical cross section adjustments do not appear to be excessive, and

there is no visual evidence of flows outflanking log structures installed to control channel gradient.

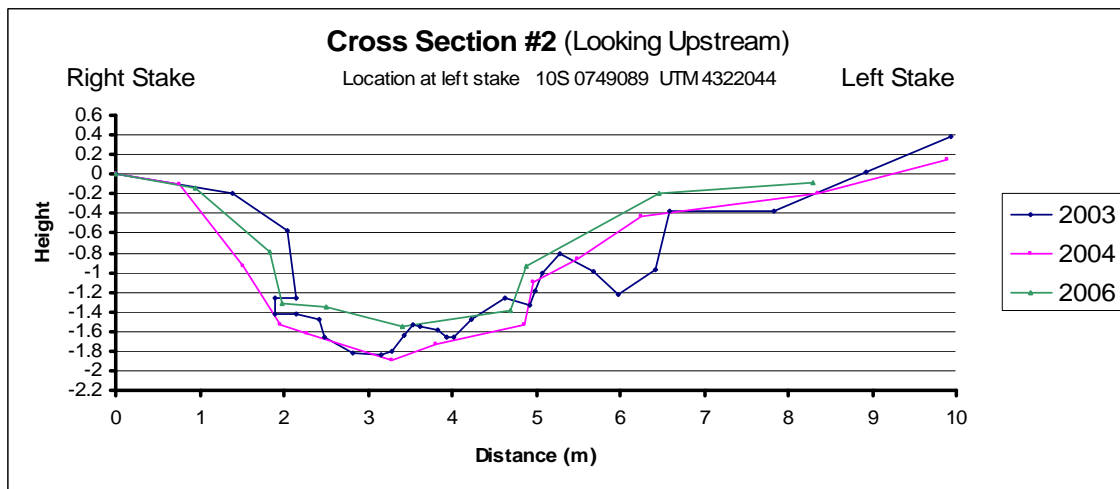
Furthermore, direct observations of riparian plantings in 2006 verified that many survived the December 31, 2005 flood. These as well as new recruits appear to be flourishing. Overall, the photos document the return of the restored channel segment to characteristics typical of a moderate-gradient, forested stream in recovery.

3. Cross sections

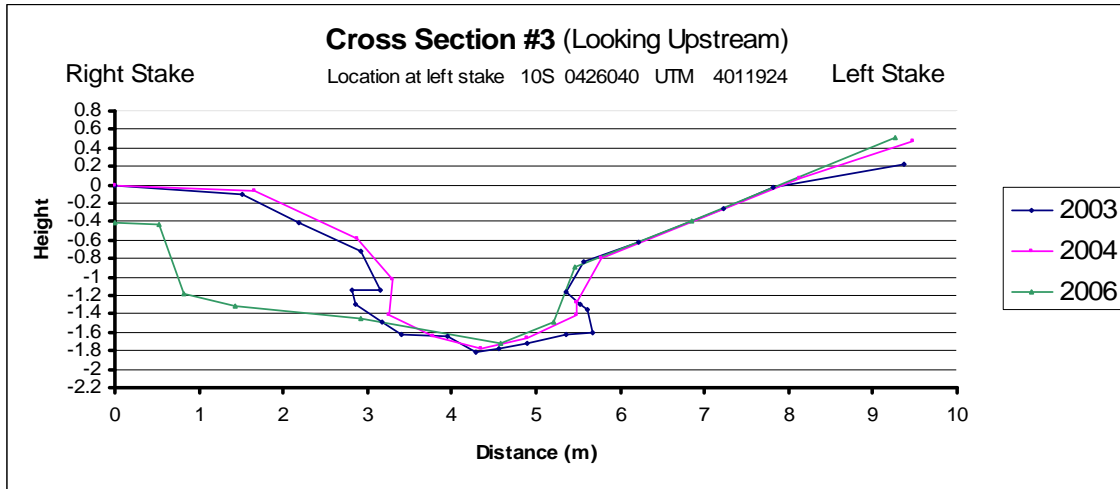
The following graphs display the results of the cross section surveys.



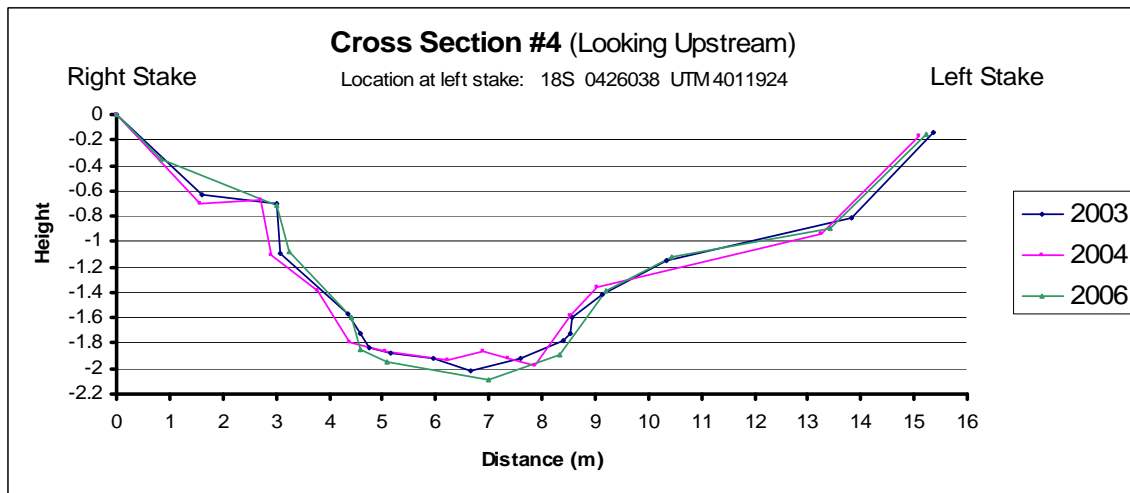
Cross-section #1. Approximately 0.5 to 0.75 meters of material eroded from the right bank while the stream bottom filled approximately 0.5 meters of sediment material. The left bank showed no change except for a boulder placed during restoration, which shifted toward the channel and left a 1-meter deep hole



Cross-section #2. Aggradation occurred on the left bank and the stream bottom. The channel aggraded to a depth of approximately 0.5 meters. Right bank displayed minor erosion.



Cross-section #3. The right bank experienced a big cut from 2003 to 2006 because a large dead tree that once stood by the channel fell creating a large steep cut bank with a block of sediment exposed. The left bank showed no change from before restoration to after restoration. The stream bottom also remained the same.



3.4 Cross-section #4. This cross section located at the downstream end of the project show no changes in deposition or erosion. This is probably because this cross section has more riparian vegetation than the other 3 cross sections.

The absence of large-scale vertical adjustment in the cross sections suggest that the long profile is stable and so far the log grade control structures installed are effective at holding the grade and maintaining a characteristic step pool form. Although there are some lateral adjustments, they are

minor in nature and do not appear to be affecting overall stability. Lateral adjustments are a result of several large rocks sliding down slope and a tree pulling away from the bank in cross sections one and three; these adjustments probably occurred during the Dec 31 2005 flood. Most importantly, flows have not outflanked any of the grade-control structures.

4. Macroinvertebrates

Based on the 6 metrics (see Table 3) utilized to derive a combined MMI (multi-metric index), Lonely Gulch received a score of 80.7 out of 100. When compared to the other 172 sampling sites that were sampled in the Lake Tahoe Basin in 2003, the Lonely Gulch MMI score placed in the top 20%. This indicates that the restoration did not have a negative biological impact on the stream condition and that the stream condition is good.

Table 3 – Metrics to used to determine macro invertebrate MMI score

Metrics Selected for Tahoe Basin Streams	Date	Plecoptera taxa	Tricoptera taxa	Long-lived taxa	Intolerant taxa	Clinger taxa	% non-insect taxa
post-restoration	9/24/2003	11	7	9	12	28	4

IV. CONCLUSIONS

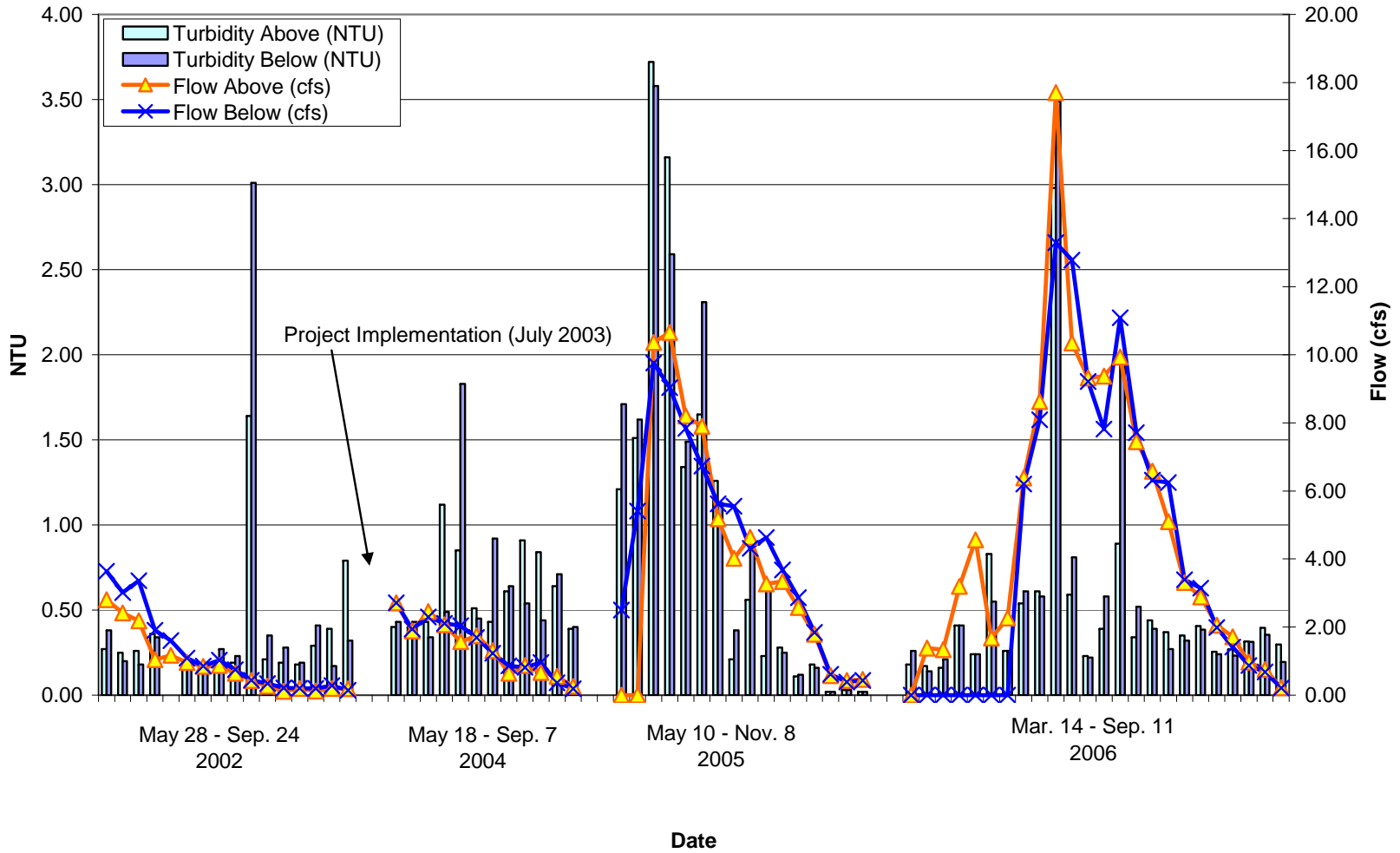
All monitoring metrics utilized indicate that a dynamically stable pool and high gradient riffle environment has been established at this site. Specifically:

- Turbidity and SSC data suggest that restoration was successful in preventing sediment pulses as result of bank failures.
- Photo documentation indicates that the stream banks are on a positive trajectory in terms of developing a riparian corridor.
- Cross sections documented that the channel is a dynamic, but stable morphology.
- Macroinvertebrate sampling indicates that the restoration reach exhibits biological characteristics that ranks within the top 20% of streams in the Tahoe Basin
- All metrics indicate the site responded well, in terms of dynamic adjustments, to a large mid winter flood in 2005.

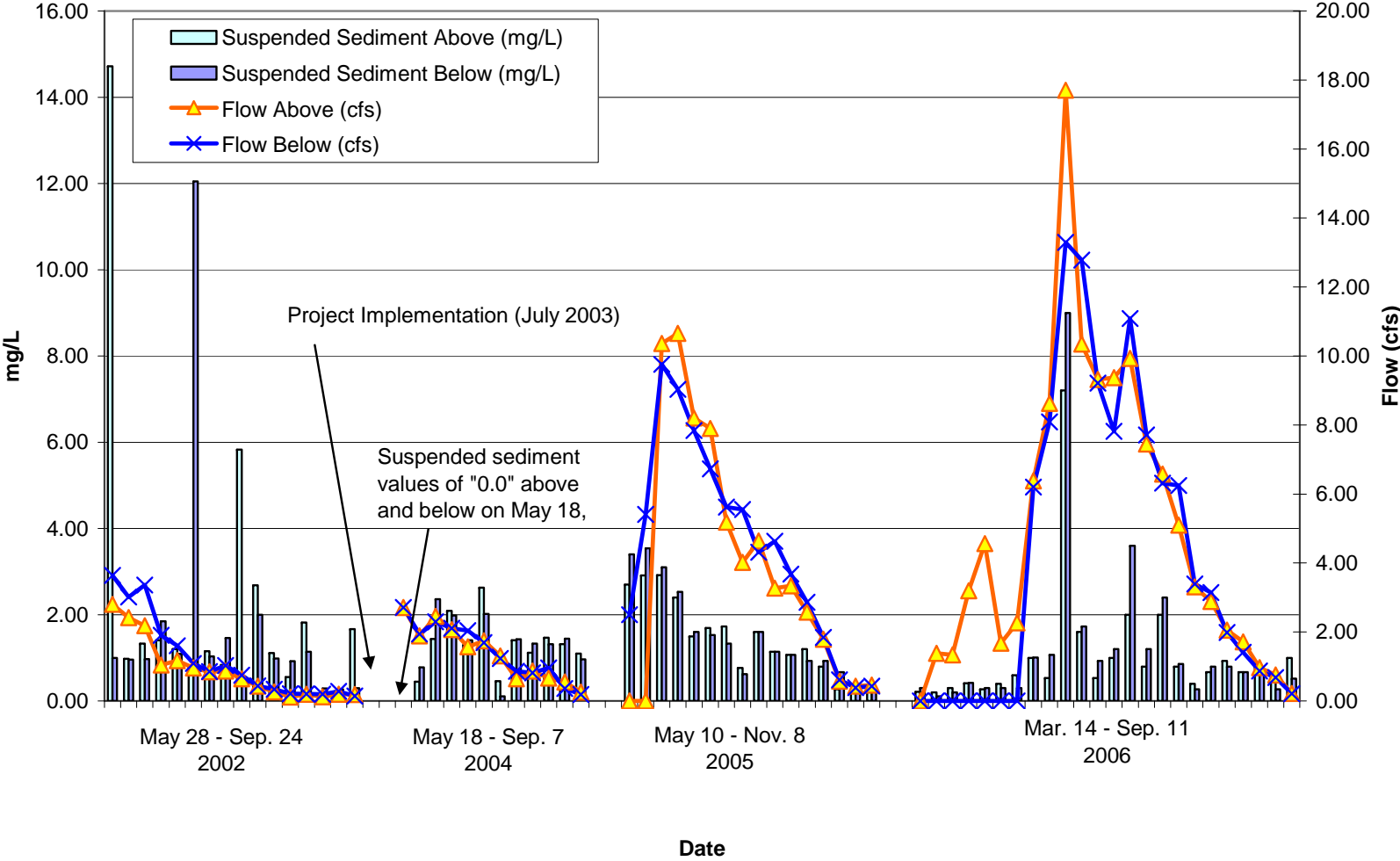
Future monitoring should consist of photopoints, repeated every three years, or after unusually large storm events. Cross section measurement should also be repeated after large storm events, if visual signs of erosion are observed during photopoint monitoring.

Appendix A1
Water Quality Graphs

Lonely Gulch - Turbidity



Lonely Gulch - Suspended Sediment



Appendix A2
Water Quality Raw Data

Table A-1. Raw data for turbidity during the period of record at Lonely Gulch Creek.

	Date	Turbidity 53-1	Turbidity 53-2	Flow 53-1	Flow 53-2
		Above Site	Below Site	Above Site	Below Site
WY2002	5/28/02	0.270	0.380	2.804	3.643
	5/28/02	0.320		2.804	
	6/4/02	0.250	0.200	2.419	3.015
	6/11/02	0.260	0.180	2.185	3.363
	6/18/02	0.360	0.340	1.044	1.906
	6/18/02		0.300		1.906
	6/25/02			1.170	1.604
	6/25/02				1.604
	7/1/02	0.200	0.160	0.961	1.085
	7/9/02	0.150	0.190	0.849	0.852
	7/9/02		0.130		0.852
	7/15/02	0.170	0.270	0.868	1.024
	7/22/02	0.190	0.230	0.641	0.750
	8/12/02	1.640	3.010	0.433	0.439
	8/20/02	0.210	0.350	0.266	0.337
	8/27/02	0.190	0.280	0.117	0.212
	9/3/02	0.180	0.190	0.195	0.202
	9/10/02	0.290	0.410	0.123	0.199
	9/17/02	0.390	0.170	0.199	0.280
	9/24/02	0.790	0.320	0.189	0.146
10/1/02	0.640	0.400	0.115	0.309	
10/9/02	0.120	0.140	0.027	0.092	
10/22/02	0.160	0.360	0.058	0.201	
11/5/02	0.130	0.440	0.122	0.320	
WY2003	6/3/03	0.680	0.450	3.455	7.038
	6/17/03	0.170	0.160	4.280	2.917
	6/24/03	0.130	0.270	3.000	3.101
	6/30/03	0.410	0.410	2.000	2.083
WY2004	5/18/04	0.4	0.4	2.71	2.71
	5/25/04	0.4	0.4	1.89	1.94
	6/1/04	0.4	0.3	2.46	2.30
	6/8/04	1.1	0.5	2.07	2.11
	6/8/04	0.7		2.07	2.110
	6/15/04	0.9	1.8	1.57	2.04
	6/22/04	0.5	0.5	1.75	1.69
	6/29/04	0.4	0.9	1.31	1.23
	7/6/04	0.6	0.6	0.64	0.86
	7/13/04	0.9	0.5	0.87	0.81
	7/20/04	0.8	0.4	0.66	0.96
	8/17/04	0.6	0.7	0.56	0.36
	9/7/04	0.4	0.4	0.26	0.19

	Date	Turbidity 53-1	Turbidity 53-2	Flow 53-1	Flow 53-2
		Above Site	Below Site	Above Site	Below Site
WY2005	5/10/05	1.2	1.7		2.50
	5/17/05	1.5	1.6		5.41
	5/24/05	3.7	3.6	10.36	9.76
	5/31/05	3.2	2.6	10.66	9.03
	6/7/05	1.3	1.5	8.20	7.84
	6/14/05	1.7	2.3	7.90	6.73
	6/21/05	1.3	1.1	5.18	5.62
	6/28/05	0.2	0.4	4.02	5.55
	7/5/05	0.6	0.9	4.64	4.31
	7/12/05	0.2	0.6	3.27	4.63
	7/19/05	0.3	0.3	3.34	3.68
	7/26/05	0.1	0.1	2.58	2.87
	8/2/05	0.2	0.2	1.79	1.84
	9/6/05	0.0	0.0	0.57	0.61
	9/27/05	0.0	0.0	0.43	0.38
	11/8/05	0.020	0.020	0.459	0.433

WY2006	3/14/06	0.180	0.260		
	3/21/06	0.170	0.140	1.379	
	3/28/06	0.160	0.210	1.338	
	4/4/06	0.410	0.410	3.196	
	4/11/06	0.240	0.240	4.564	
	4/18/06	0.830	0.550	1.673	
	4/25/06	0.260	0.260	2.263	
	5/2/06	0.540	0.610	6.384	6.204
	5/9/06	0.610	0.580	8.624	8.090
	5/16/06	2.980	3.490	17.704	13.292
	5/23/06	0.590	0.810	10.346	12.783
	5/30/06	0.230	0.220	9.323	9.218
	6/6/06	0.390	0.580	9.373	7.817
	6/13/06	0.890	1.960	9.932	11.091
	6/20/06	0.340	0.520	7.449	7.713
	6/27/06	0.440	0.390	6.578	6.313
	7/5/06	0.370	0.270	5.097	6.246
	7/12/06	0.350	0.320	3.306	3.389
	7/19/06	0.406	0.385	2.883	3.141
	7/25/06	0.255	0.240	2.057	1.984
	8/2/06	0.269	0.233	1.717	1.416
	8/10/06	0.315	0.313	0.965	0.872
8/16/06	0.396	0.355	0.752	0.683	
9/11/06	0.298	0.195	0.219	0.212	

Table A-2. Raw data for suspended sediment during the period of record at Lonely Gulch Creek.

	Date	SS 53-1	SS 53-2	Flow 53-1	Flow 53-2
		Above Site	Below Site	Above Site	Below Site
WY2002	5/28/02	14.720	1.000	2.804	3.643
	5/28/02	3.520		2.804	
	6/4/02	0.980	0.960	2.419	3.015
	6/11/02	1.330	0.970	2.185	3.363
	6/18/02	1.410	1.850	1.044	1.906
	6/18/02				1.906
	6/25/02	1.202	1.091	1.170	1.604
	6/25/02		1.647		1.604
	7/1/02	0.810	12.050	0.961	1.085
	7/9/02	1.156	1.032	0.849	0.852
	7/9/02		1.013		0.852
	7/15/02	0.833	1.463	0.868	1.024
	7/22/02	5.828	0.540	0.641	0.750
	8/12/02	2.683	2.000	0.433	0.439
	8/20/02	1.111	0.986	0.266	0.337
	8/27/02	0.555	0.923	0.117	0.212
	9/3/02	1.818	1.139	0.195	0.202
	9/10/02	0.125	0.288	0.123	0.199
	9/17/02	0.224	0.270	0.199	0.280
	9/24/02	1.667	0.298	0.189	0.146
10/1/02			0.115	0.309	
10/9/02			0.027	0.092	
10/22/02			0.058	0.201	
11/5/02	0.789	2.690	0.122	0.320	
WY2003	6/3/03	3.900	10.700	3.455	7.038
	6/17/03	27.900	21.600	4.280	2.917
	6/24/03	0.400	0.200	3.000	3.101
	6/30/03	8.000	1.100	2.000	2.083
WY2004	5/18/04	0.00	0.00	2.71	2.71
	5/25/04	0.45	0.78	1.89	1.94
	6/1/04	1.44	2.36	2.46	2.30
	6/8/04	2.09	1.98	2.07	2.11
	6/8/04	1.96		2.07	
	6/15/04	1.30	1.41	1.57	2.04
	6/22/04	2.63	2.02	1.75	1.69
	6/29/04	0.46	0.11	1.31	1.23
	7/6/04	1.41	1.43	0.64	0.86
	7/13/04	1.12	1.33	0.87	0.81
	7/20/04	1.47	1.32	0.66	0.96
	8/17/04	1.32	1.45	0.56	0.36
9/7/04	1.10	0.96	0.26	0.19	

	Date	SS 53-1	SS 53-2	Flow 53-1	Flow 53-2
		Above Site	Below Site	Above Site	Below Site
WY2005	5/10/05	2.7	3.4		2.50
	5/17/05	2.91	3.54		5.41
	5/24/05	2.92	3.1	10.36	9.76
	5/31/05	2.4	2.53	10.66	9.03
	6/7/05	1.5	1.6	8.20	7.84
	6/14/05	1.69	1.53	7.90	6.73
	6/21/05	1.73	1.33	5.18	5.62
	6/28/05	0.77	0.62	4.02	5.55
	7/5/05	1.6	1.6	4.64	4.31
	7/12/05	1.14	1.14	3.27	4.63
	7/19/05	1.07	1.07	3.34	3.68
	7/26/05	1.2	0.93	2.58	2.87
	8/2/05	0.8	0.93	1.79	1.84
	9/6/05	0.27	0.67	0.57	0.61
	9/27/05	0.27	0.40	0.43	0.38
11/8/05	0.27	0.27	0.459	0.433	

WY2006	3/14/06	0.21	0.30		
	3/21/06	0.20	0.11	1.379	
	3/28/06	0.30	0.20	1.338	
	4/4/06	0.41	0.42	3.196	
	4/11/06	0.27	0.30	4.564	
	4/18/06	0.40	0.30	1.673	
	4/25/06	0.60	0.30	2.263	
	5/2/06	1.00	1.01	6.384	6.204
	5/9/06	0.53	1.07	8.624	8.090
	5/16/06	7.20	9.00	17.704	13.292
	5/23/06	1.60	1.73	10.346	12.783
	5/30/06	0.53	0.93	9.323	9.218
	6/6/06	1.00	1.20	9.373	7.817
	6/13/06	2.00	3.60	9.932	11.091
	6/20/06	0.80	1.20	7.449	7.713
	6/27/06	2.00	2.40	6.578	6.313
	7/5/06	0.80	0.86	5.097	6.246
	7/12/06	0.40	0.27	3.306	3.389
	7/19/06	0.67	0.80	2.883	3.141
	7/25/06	0.93	0.80	2.057	1.984
	8/2/06	0.67	0.67	1.717	1.416
8/10/06	0.80	0.67	0.965	0.872	
8/16/06	0.53	0.27	0.752	0.683	
9/11/06	1.00	0.52	0.219	0.212	

Appendix B
Photopoints

Appendix B – Photopoints

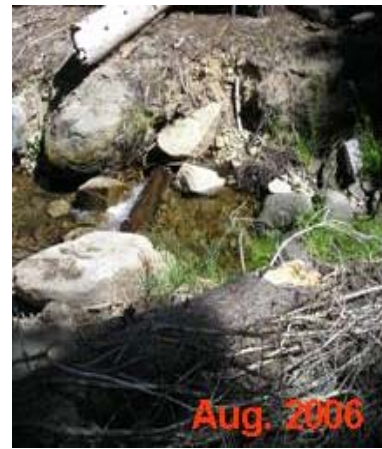
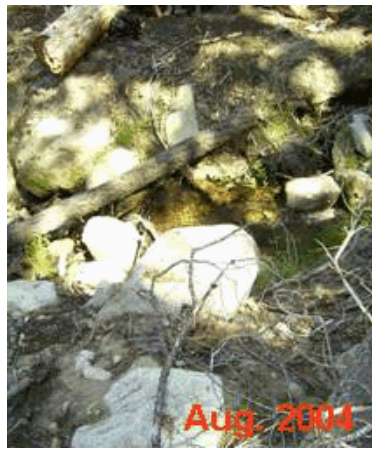
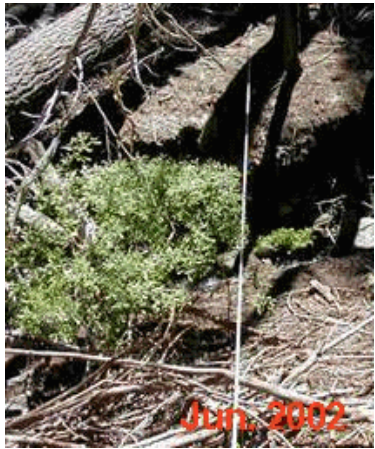


Photo Series #1. Photo taken looking down cross section #1 at right bank (UTM 10s 749002 4322212. Compass bearing 90°).



Photo Series #2. Photo taken on cross section #1 in center of channel looking downstream (UTM 10s 749002 4322212. Compass bearing 20°).



Photo Series #3. Photo taken looking down cross section #2 at left bank (UTM 10s 0749013 4322226. Compass bearing 280°).



Photo Series #4. Photo taken looking down cross section #2 at right bank (UTM 10s 0749013 4322226. Compass bearing 90°).



Photo Series #5. Photo taken on cross section #2 in center of channel looking upstream (UTM 10s 0749013 4322226. Compass bearing 165°).

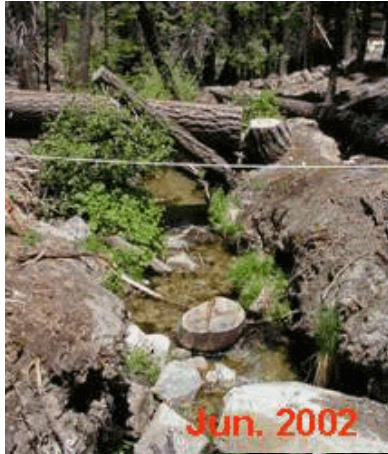


Photo Series #6. Photo taken on cross section #2 in center of channel looking downstream (UTM 10s 0749013 4322226. Compass bearing 10°).

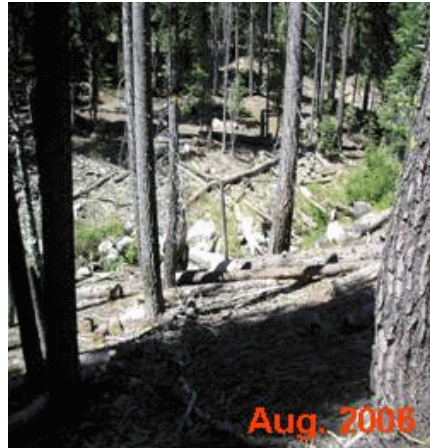


Photo Series #7. Photo taken from photopoint #4 (UTM 10s 0749017 4322205. Compass bearing 290°).

Appendix C – Macroinvertebrate data

Lonely Gulch Species List

Turbellaria	Non insect	flat worm	25
Oligochaeta	Non insect	segmented worm	7
Ostracoda	Non insect	seed shrimp	1
Acari	Non insect	mite	4
<i>Ameletus</i>	Ephemeroptera	Ameletidae	2
<i>Baetis tricaudatus</i>	Ephemeroptera	Baetidae	19
<i>Dipheter hageni</i>	Ephemeroptera	Baetidae	3
<i>Drunella doddsi</i>	Ephemeroptera	Ephemerellidae	1
<i>Drunella grandis/spinifera</i>	Ephemeroptera	Ephemerellidae	1
<i>Serratella ?levis</i>	Ephemeroptera	Ephemerellidae	39
<i>Cinygmula</i>	Ephemeroptera	Heptageniidae	1
<i>Ironodes</i>	Ephemeroptera	Heptageniidae	1
<i>Rhithrogena</i>	Ephemeroptera	Heptageniidae	3
Capniidae	Plecoptera	Capniidae	2
Chloroperlidae	Plecoptera	Chloroperlidae	1
<i>Sweltsa</i>	Plecoptera	Chloroperlidae	4
<i>Moselia infuscata</i>	Plecoptera	Leuctridae	2
<i>Soyedina</i>	Plecoptera	Nemouridae	1
<i>Visoka cataractae</i>	Plecoptera	Nemouridae	8
<i>Zapada cinctipes</i>	Plecoptera	Nemouridae	9
<i>Zapada columbiana</i>	Plecoptera	Nemouridae	3
<i>Zapada Oregonensis Group</i>	Plecoptera	Nemouridae	2
<i>Doroneuria</i>	Plecoptera	Perlidae	17
<i>Yoraperla</i>	Plecoptera	Peltoperlidae	9
<i>Micrasema</i>	Trichoptera	Brachycentridae	46
<i>Parapsyche elsis</i>	Trichoptera	Hydropsychidae	38
<i>Lepidostoma</i>	Trichoptera	Lepidostomatidae	4
<i>Rhyacophila Betteni Group</i>	Trichoptera	Rhyacophilidae	2
<i>Rhyacophila Brunnea/Vemna Group</i>	Trichoptera	Rhyacophilidae	5
<i>Rhyacophila pellisa/valuma</i>	Trichoptera	Rhyacophilidae	5
<i>Neothremma</i>	Trichoptera	Uenoidae	226
Ceratopogoninae	Diptera	Ceratopogonidae	5
<i>Glutops</i>	Diptera	Pelecorhynchidae	1
<i>Prosimulium</i>	Diptera	Simuliidae	1
<i>Simulium</i>	Diptera	Simuliidae	21
Chironomidae-pupae	Diptera	Chironomidae	2
<i>Brillia</i>	Diptera	Chironomidae	3
<i>Eukiefferiella</i>	Diptera	Chironomidae	7
<i>Micropsectra</i>	Diptera	Chironomidae	1
<i>Orthocladius Complex</i>	Diptera	Chironomidae	1
<i>Pagastia</i>	Diptera	Chironomidae	5
<i>Paraphaenocladius</i>	Diptera	Chironomidae	2
<i>Parorthocladius</i>	Diptera	Chironomidae	1
<i>Tvetenia Bavarica Group</i>	Diptera	Chironomidae	9
		TOTAL # ID'd	550

Lonely Gulch Result Report

Site # 1

Diversity Indices	Date	Total taxa richness	EPT taxa richness	Shannon diversity index	Simpson diversity index	Evenness
post-restoration	9/24/2003	44	27	2.48		0.6557

Intolerant/Tolerant richness and abundance	Date	Intolerance taxa Richness	Tolerant taxa Richness	Empheroptera taxa
post-restoration	9/24/2003	12	4	9

Functional Feeding group Percentage	Date	Shredders	Scrapers	Collector-filters	Collector-gatherers	Predators
post-restoration	9/24/2003	7.85	50.73	4.01	17.88	19.53

Metrics Selected for Tahoe Basin Streams	Date	Plecoptera taxa	Tricoptera taxa	Long-lived taxa	Intolerant taxa	Clinger taxa	% non-insect taxa
post-restoration	9/24/2003	11	7	9	12	28	4

Metrics Selected for Tahoe Basin Streams

Metric	Scoring rule	9/24/2003
Plecoptera taxa	$(x-3)*(10/7)$	11.428571
Tricoptera taxa	$(x-3)*(10/7)$	5.7142857
Long-lived taxa	$(x-2)*(10/9)$	7.7777778
Intolerance taxa	$(x-9)*(10/17)$	1.7647059
Clinger taxa	$(x-11)*(10/14)$	12.142857
% non-insect taxa	$10-((x-3.6)*(10/9.4))$	9.5744681
	Score	48.402666
	Final Score	80.67111