Friends of Corte Madera Creek Watershed
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DRAFT
2012 Water Quality Report

Corte Madera Creek Watershed

Prepared by

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December 27, 2012

MMWD provides essential logistical support in both the deployment and ongoing maintenance of our equipment. Eric Ettlinger drives us to the lake from Sky Oaks Ranger Station, and assists us in reaching our deployment in a MMWD boat. He has helped us install the loggers, and download them. This project would not be possible without his help and the support of the resources staff, particularly Mike Swezy.

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List of Tables and Figures

1: Background

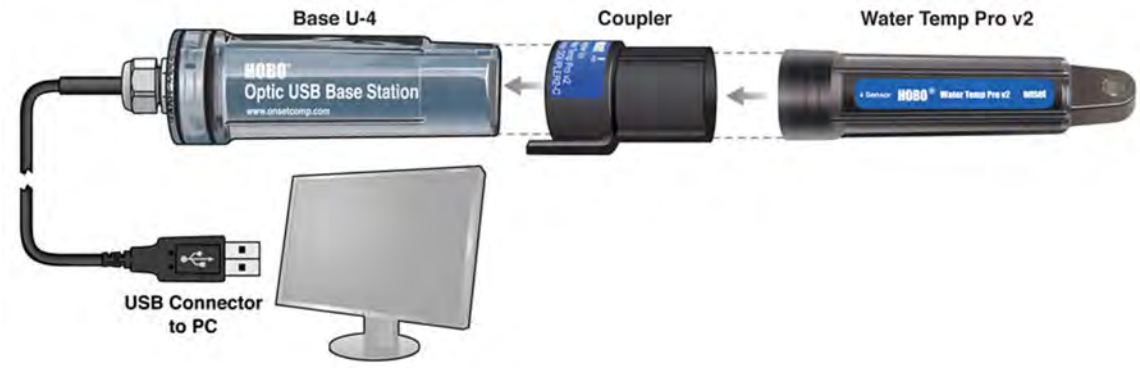
The purpose of the monitoring is to characterize the temperature regimes and document dissolved oxygen (DO) in Phoenix Lake and at various locations in creeks in the Corte Madera Creek watershed. We have installed loggers in Phoenix Lake and Ross Creek each year beginning in 2008. In 2009 we added loggers in Bill Williams Creek and Phoenix Creek, tributaries to Phoenix Lake. In 2012, we added loggers in Corte Madera Creek, San Anselmo Creek, Fairfax Creek, and Sleepy Hollow Creek. Typically the loggers are installed in March or April and removed when the creek dries up or when winter rains start.

The information from the creeks is used to evaluate the suitability of temperature and dissolved oxygen (DO) for steelhead trout. For Phoenix Lake, this information will inform the evaluation of how releases from Phoenix Lake could benefit steelhead trout in Ross Creek. For steelhead, suitable temperatures are generally 12 – 18°C. Suitable DO is a function of temperature: at temperatures ≤15°C, DO ≥ 7 milligrams per liter (mg/l) is suitable. At higher temperatures, DO should be ≥9 mg/l.

2: Equipment

We use Onset Computer's HOBO Water Temp Pro v2 loggers (Figure 1). They are downloaded in the field using a waterproof data shuttle (base station) to collect the data and launch the logger. In the office, we connect the shuttle to a computer and readout the data. When loggers are installed, downloaded, and removed, we measure temperature and dissolved oxygen (DO). We began the season using a Quanta Hydrolab, which measured temperature, DO, pH, and specific conductivity; it failed expensively, so we replaced it with a YSI Pro20 instrument, a simpler device that measures only temperature and DO.

Figure 1: Diagram of logger, shuttle, and computer used in data collection and transfer



3: Logger Installation

Figure 2 shows the locations of loggers in and around Phoenix Lake. Figure 3 shows the logger locations further upstream. Table 1 lists the 2012 dates of installation and removal of loggers at each location.

The temperature loggers are designed for long-term deployment and are relatively robust. In Phoenix Lake, the loggers were attached to a rope with an 8-lb anchor at the bottom and three floats on the top. Loggers

were attached at elevations measured from the bottom of the lake of 1, 6, 11, 16, 21, 26, and 31, and 36 feet. The lake is typically 37 to 39 feet deep where the loggers are deployed.

In creeks, each logger is attached to a stainless steel cable with a shackle; the cable is fastened to a rock or tree root. We are careful to hide the cable and logger, but they are not completely invisible. These loggers are more vulnerable to damage from rocks in the water or curious passers-by. To provide some protection, we place the loggers in protective plastic covers (boots). Unfortunately, areas where people have easy access to the creek have proved problematical. A logger was stolen in 2011 from RC1.5; in 2012, we moved it to a less obvious location and put up a sign describing the purpose of the logger; someone moved this logger in 2012, but it was not stolen. In 2012, the logger just below the confluence of Fairfax Creek and San Anselmo Creek (SA20) appears to have been removed from the water between 7/8/12 and 7/27/12 then put back into the water. Sometime between 8/5/12 and 8/29/12 it was detached from the cable and stolen. We put up a sign requesting its return, to no effect.

Figure 2. Temperature logger locations in Phoenix Lake, two tributaries to the lake, Ross Creek, and two loggers in the mainstem upstream and downstream of the mouth of Ross Creek

Figure 3: Temperature logger locations in Fairfax and San Anselmo

For loggers in creeks, we attempt to locate sites with relatively deep, moving water; the deepest pools are not selected, because we want to measure the temperature of water moving in the creek. Unfortunately, as water levels drop, we find that some loggers are in stratified pools with no current.

4: Data Gathering and Analysis

Before each logger is downloaded, the YSI unit is used to measure temperature and DO. The YSI unit is accurate for DO only in moving water. Where the water is still, the sensor must be kept moving so that the oxygen immediately adjacent to the sensor is not depleted before the reading is stabilized. This works only moderately well later in the summer when water levels are low and some of the pools have stratified. Readings for both temperature and DO vary significantly within one pool when the water is mixed by the moving probe.

Loggers were set to record data points every 30 minutes, except for those at the Lansdale Fish Passage Improvement Project; these recorded data every 15 minutes. Loggers in creeks were downloaded approximately monthly.

To download the loggers in Phoenix Lake, the rope is lifted from the lake into an MMWD boat, each logger is connected to the data shuttle, which reads and then empties the logger memory. After all loggers are downloaded, the string is replaced at approximately the same location. The loggers are downloaded approximately monthly when possible. Because MMWD staff is often fully committed to conducting

Table 1: Information about logger deployment in 2012

Location	Creek	Latitude	Longitude	Logger ID	Installed	Removed	Notes
Phoenix Lake	n/a	37.954999	-122.576904	8 different	4/17/12	11/2/12	
BWC	Bill Williams	37.948576	-122.573626	1211537	4/18/12	11/11/12	Top of logger out of water
PC	Phoenix	37.954498	-122.582316	1211538	4/18/12	11/2/12	
Near Vault	Ross	37.955862	-122.574989	1292332	4/3/12	11/9/12	Located in the creek, ~15 ft downstream of vault
RC1	Ross	37.955790	-122.574700	1292333	4/3/12	8/6/12	FCD installed new logger; this logger moved to Lansdale
RC1.5	Ross	37.959370	-122.572446	1292334	4/3/12	11/9/12	
RC2	Ross	37.960875	-122.571561	1211534	4/3/12	11/9/12	
RC3	Ross	37.964372	-122.564896	1292335	4/3/12	7/12/12	Dry when removed
RC4	Ross	37.966125	-122.559786	1281280	4/3/12	6/13/12	Dry; moved to Lansdale
CMC1	San Anselmo	37.966260	-122.559528	10094553	4/11/12	11/9/12	Just upstream of confluence with Ross Creek
CMC2	Corte Madera	37.965365	-122.558619	10094552	4/3/12	11/9/12	Just downstream of confluence with Ross Creek
FC10	Fairfax	37.996175	-122.599255	1211540	4/11/12	11/9/12	
FC20	Fairfax	37.98758	-122.592675	1211541	4/11/12	11/9/12	
SA15	San Anselmo	37.983665	-122.589934	1211539	4/24/12	11/9/12	
SA20	San Anselmo	37.984737	-122.588559	1211542	4/24/12	11/9/12	
Lansdale US1	San Anselmo	37.982849	-122.579012	1281280	6/25/12	10/30/12	
Lansdale US2	San Anselmo	37.982806	-122.578785	1292333	8/7/12	10/9/12	Attached to upstream fish screen
Lansdale DS	San Anselmo	37.982329	-122.576429	1292335	7/15/12	10/30/12	
SH20	Sleepy Hollow	37.985566	-122.572100	1211543	4/11/12	11/9/12	

salmonid surveys in Lagunitas Creek, sometimes the intervals are longer. In 2012, the Hydrolab failed and until we replaced it, we did not download any loggers. By the time we had replaced the Hydrolab with the YSI instrument, MMWD staff was not available for interim downloads.

5: Water Temperature and Dissolved Oxygen in Phoenix Lake

To better understand the temperature dynamics of Phoenix Lake, loggers have been deployed in Phoenix Lake each summer since 2008. Figure 2 shows the approximate location of the string of loggers.

Figure 4 is a graph of seven temperature profiles derived from 2012 logger data. Each profile is a snapshot of temperatures at the same time at eight depths. Figure 5 shows profiles of DO. Unfortunately, we have DO data for only two dates. Figure 6 is a time series of the temperatures recorded by each logger between 4/17/12 and 11/2/12.

The lake showed weak stratification when the loggers were installed; the stratification intensified until late August, when temperatures in the upper levels began to drop. Notice that the water below 11 feet above the lake bottom continued to warm, even as the surface temperatures were dropping. If water were released from a low-level valve to provide fish flows, it would need to come from the cool water pool below a level of about 15 feet from the current lake bottom.

Figure 4: Temperature profiles in Phoenix Lake

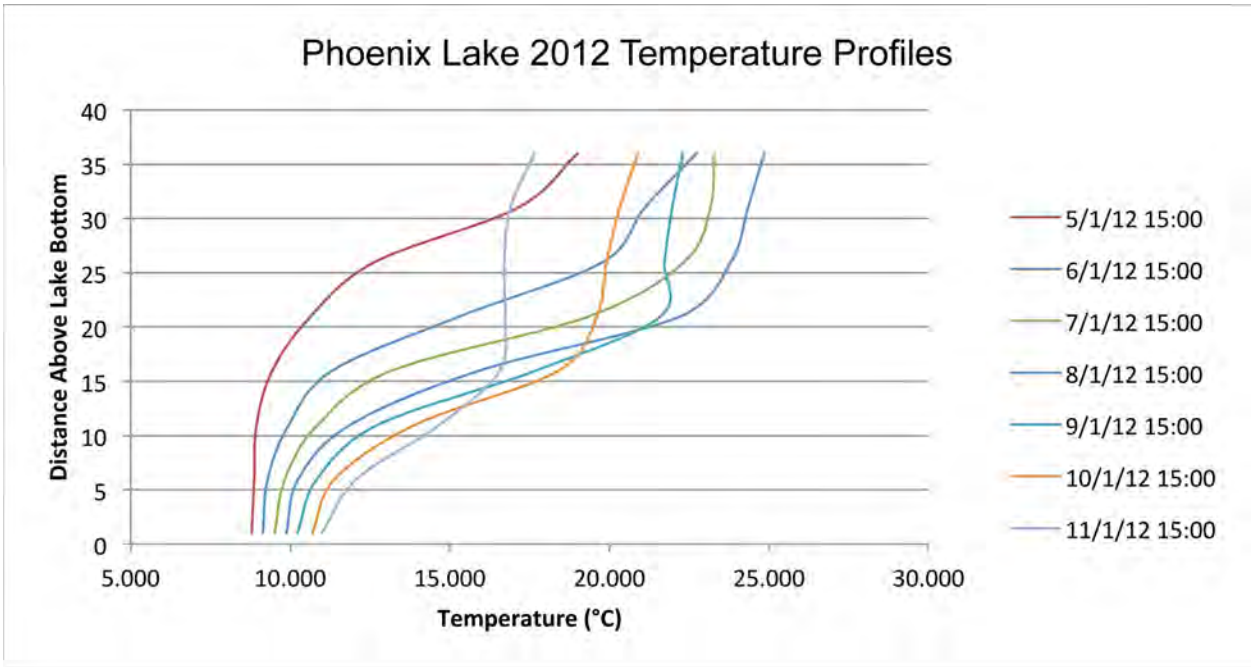


Figure 5: Dissolved oxygen profiles in Phoenix Lake

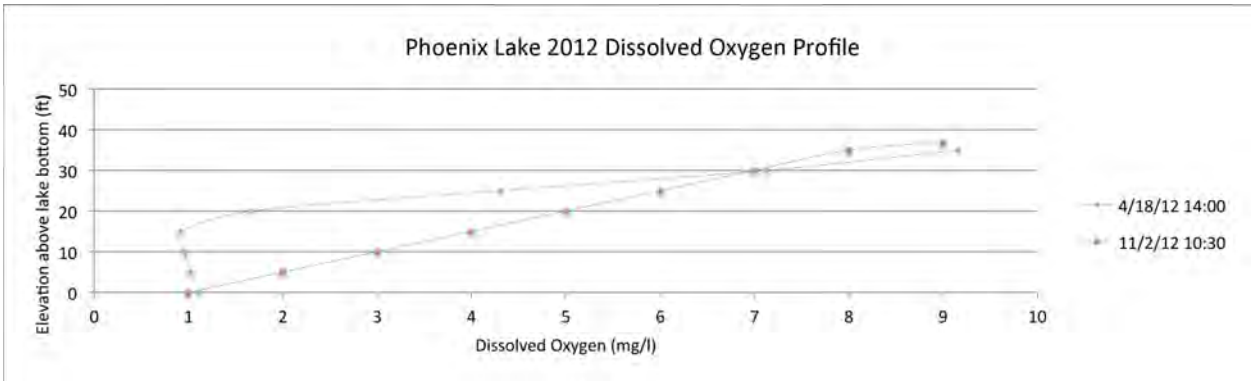
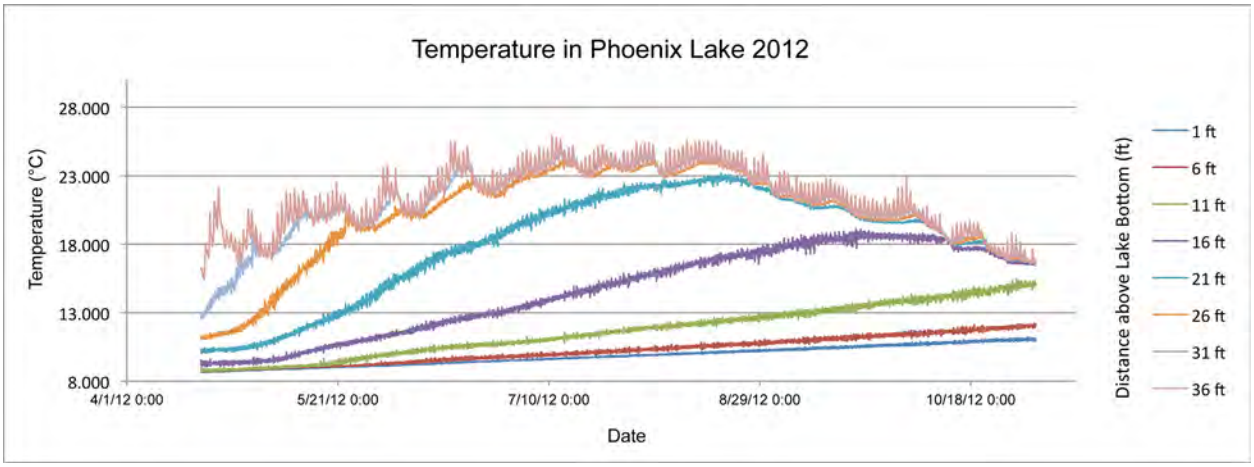


Figure 6: Temperature time series in Phoenix Lake



6: Water Temperature and Dissolved Oxygen in Ross Creek

Eight loggers were installed in Ross Creek or in the mainstem near the mouth of Ross Creek. Plots of temperature of these loggers are in Figure 7 through Figure 14. Logger RC1 was removed when the Flood Control District installed a replacement at a slightly different location. Loggers RC3 and RC4 were removed when the creek dried. The other loggers were in place from early April until early November. The specific dates of installation and removal are in Table 1.

The two upstream loggers (Figure 7 [Vault] and Figure 8 [RC1]) show the effect on Ross Creek of water flowing over the spillway at Phoenix Lake. When water flows over the spillway in late spring, the water in the upstream portion of Ross Creek is dominated by warm surface water from Phoenix Lake; both temperature the DO are high. After the lake level drops below the spillway, the water temperature and DO drop dramatically; at that point, Ross Creek flow is dominated by leakage from the low-level release valve and groundwater. Near the dam, most of the groundwater probably seeps through the earth-fill dam. When flow over the dam stops, the water in this reach has very high iron and manganese levels. (Go to http://friendsofcortemaderacreek.org/new_site/restoration/water-quality/ and download FeMn_Report_2011.pdf for details about iron and manganese levels observed in upper Ross Creek.

When we removed the vault logger on 11/9/12, we found that the sleeves used to attach the logger to the cable had corroded; the logger was floating above the end of the cable, but not connected to it. The last calibration temperature, taken where we expected the logger to be, is 1.8°C lower than the logger recorded near the water surface. There was so much orange slurry from the high iron content of the water that nothing was visible.

Data from loggers lower in Ross Creek (Figure 9 through Figure 12) record increasing DO. The temperatures are also more impacted by air temperature and diurnal swings in temperature.

Figure 7: Time series of temperature and DO recorded near the vault

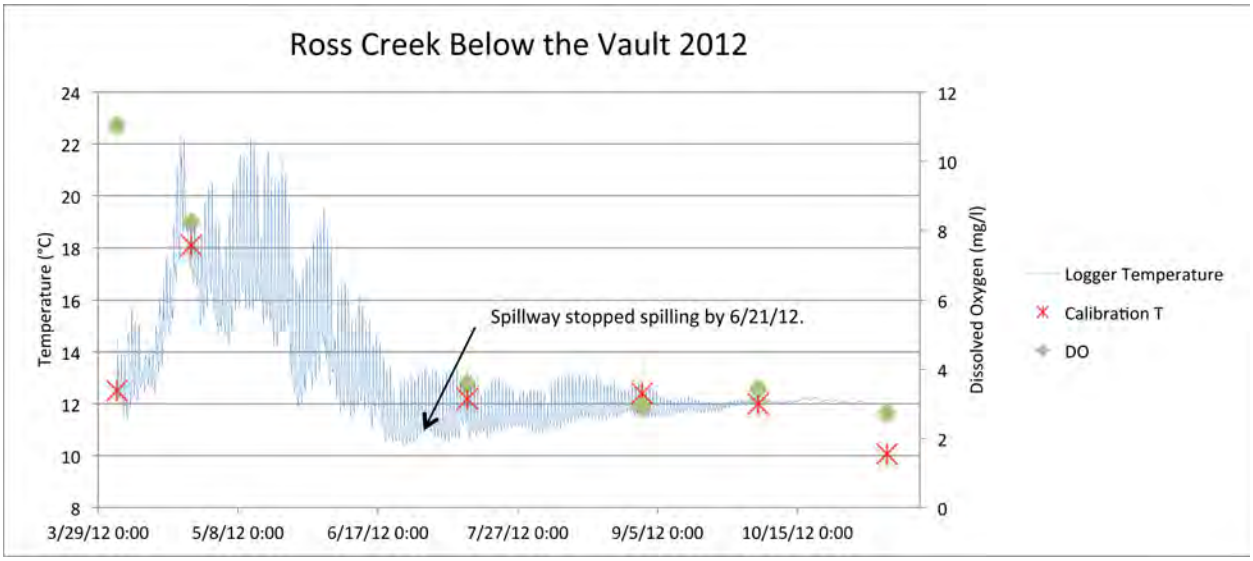


Figure 8: Time series of temperature and DO recorded by logger RC1

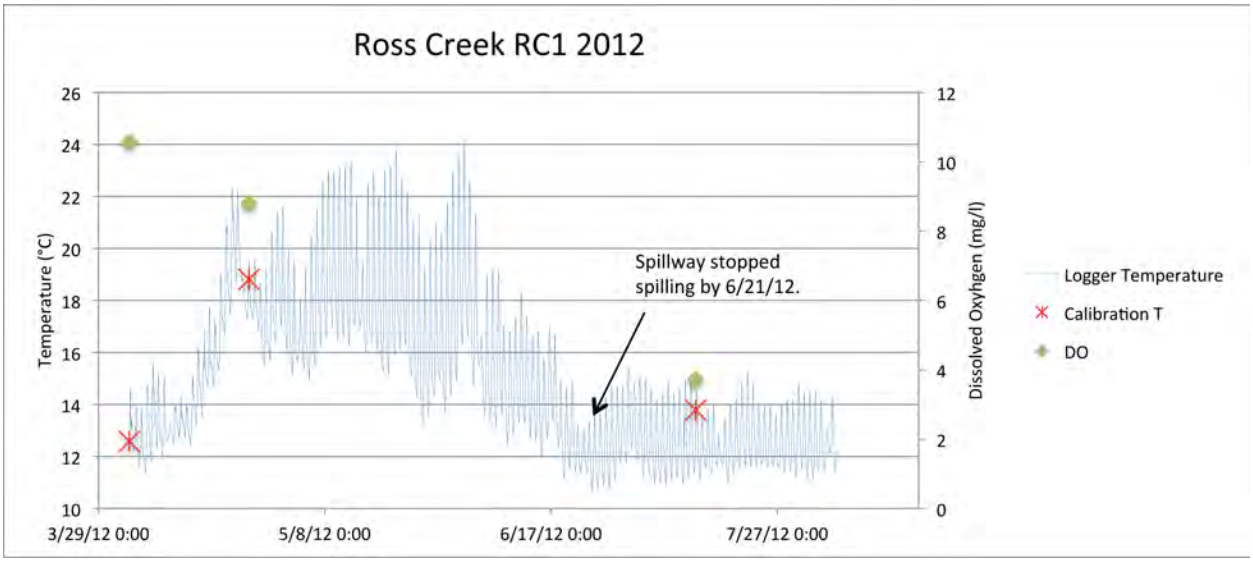


Figure 9: Time series of temperature and DO recorded by logger RC1.5

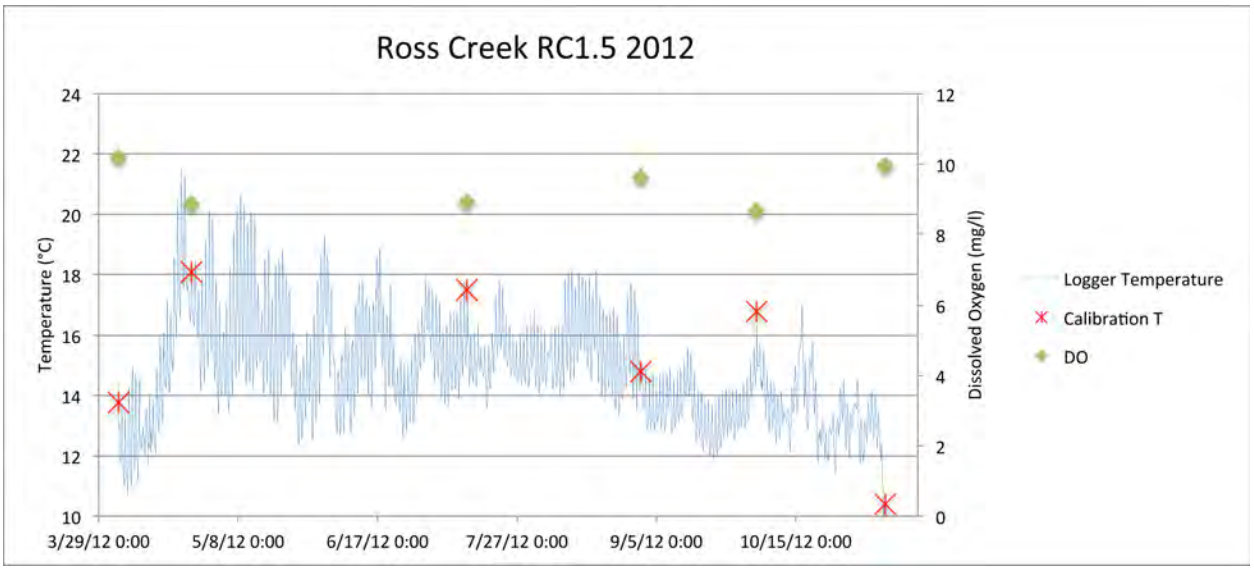


Figure 10: Time series of temperature and DO recorded by logger RC2

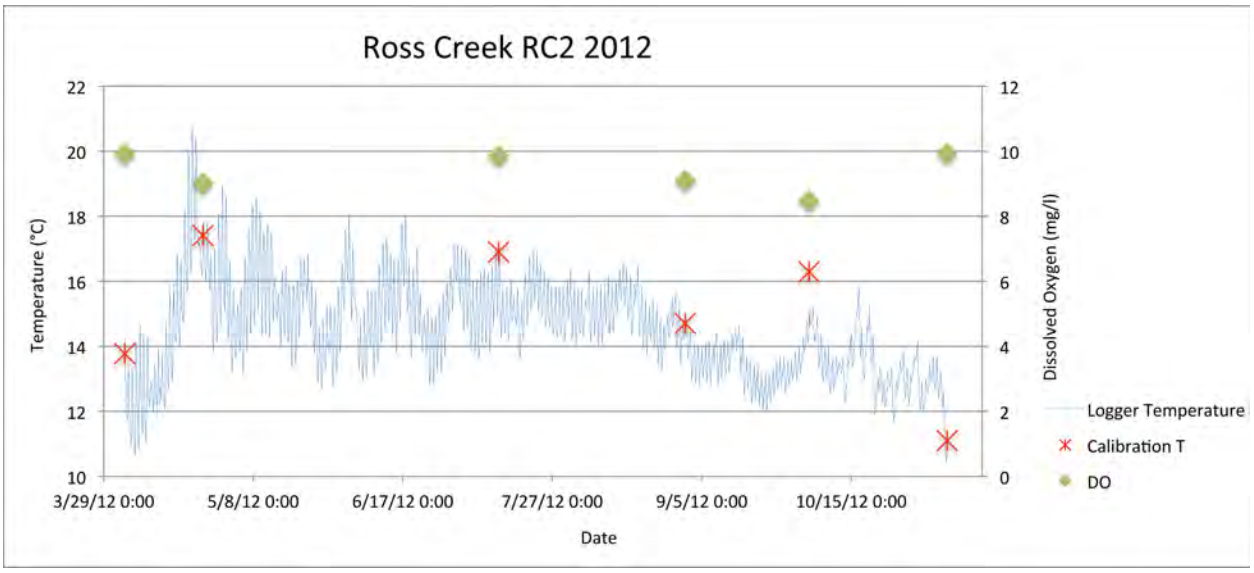


Figure 11: Time series of temperature and DO recorded by logger RC3

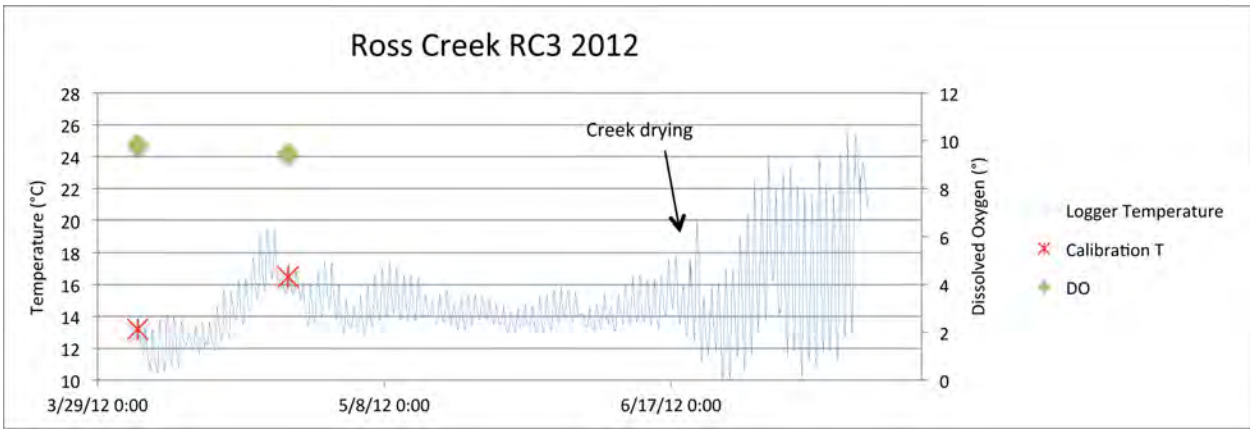


Figure 12: Time series of temperature and DO recorded by logger RC4

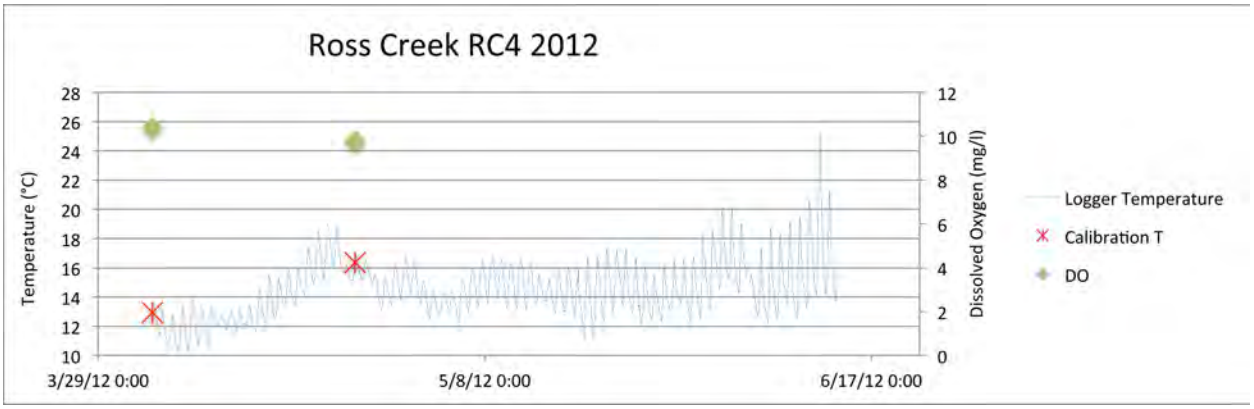


Figure 13: Time series of temperature and DO recorded by logger CMC1

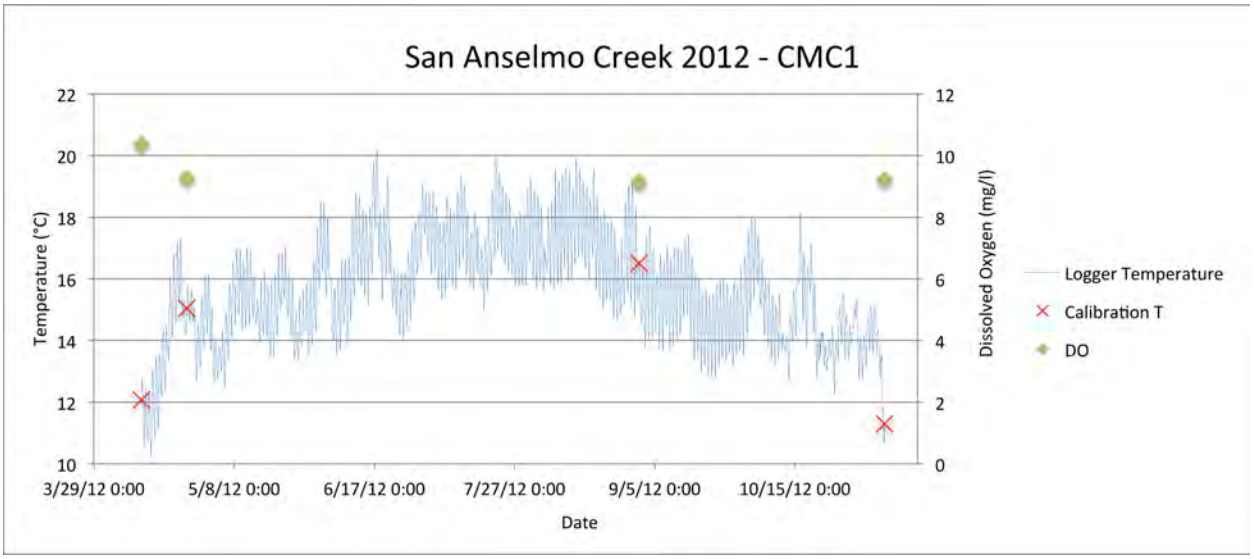
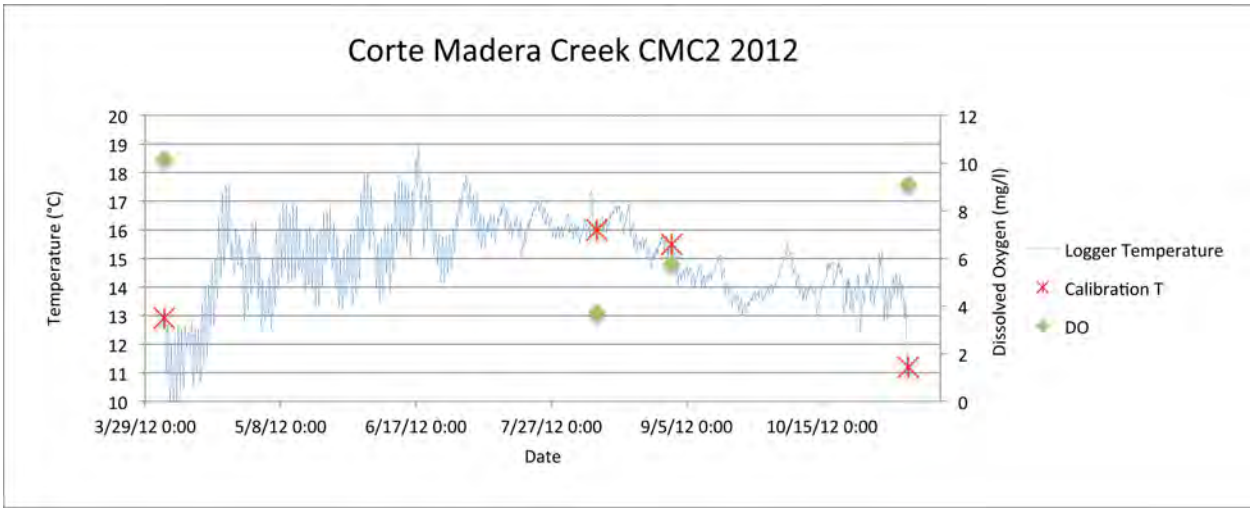


Figure 14: Time series of temperature and DO recorded by logger CMC2



7: Water Temperatures and Dissolved Oxygen in San Anselmo Creek

In 2012, loggers were deployed for an entire season in San Anselmo Creek for the first time. Two loggers were installed near the confluence of San Anselmo and Fairfax creeks, one upstream (SA15) and one downstream (SA20). Time series for these two loggers are in Figure 15 and Figure 16 respectively. SA15 stayed in place the entire season. Logger SA20 was tampered with on at least three occasions. Temperatures upstream of Fairfax Creek were higher than those downstream of the confluence, but for the most part were suitable for steelhead. The DO was exceedingly low in August. This may have reflected challenges using the new instrument, which is not designed for use in slowly moving or still water.

Figure 15: Time series of temperature and DO recorded by logger SA15

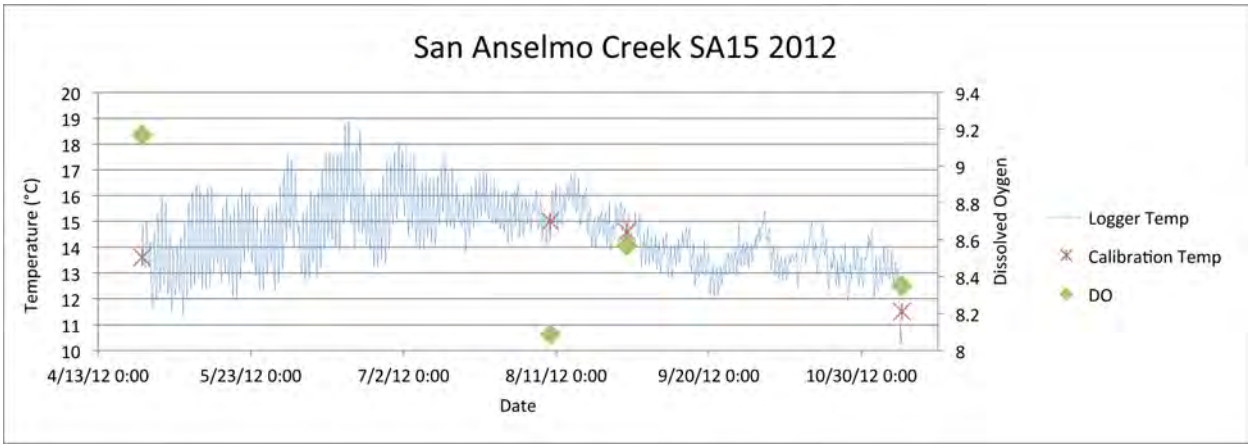
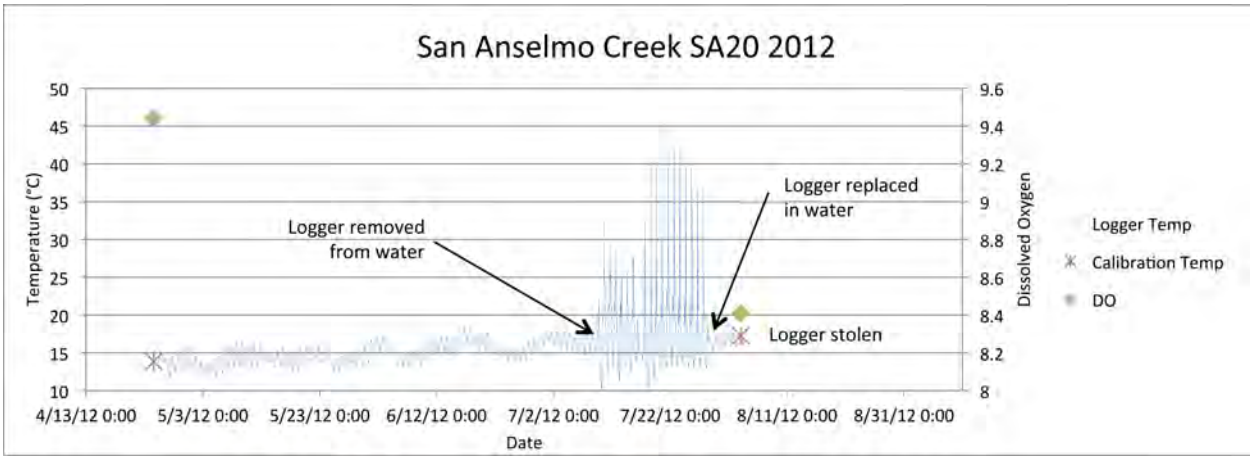


Figure 16: Time series of temperature and DO recorded by logger SA20



Further downstream on San Anselmo Creek, three loggers were used to monitor temperatures upstream and downstream of a water diversion around construction at the Lansdale Fish Passage Improvement Project. The California Department of Fish and Game expressed concern that water would become heated while in the pipe conveying water through the work area. The first upstream logger was installed in an undercut pool at the base of a retaining wall on the left bank of the creek well upstream of the diversion intake. The results from that logger show consistently low temperatures, but without the diurnal temperature variation typical of relatively shallow streams. We suspect that there was significant groundwater input from the landscaped garden above the retaining wall at that location. We installed another logger, attached to the upstream fish screen in the middle of the stream to capture more typical upstream temperatures. The downstream logger was in a pool beside some rocks on the left bank of the creek. Figure 17 is a time series for both upstream loggers; Figure 18 shows the time series for the downstream logger. The water was somewhat warmer downstream of the diversion, but still within the range considered acceptable for steelhead. DO was suitable most of the time.

8: Water Temperatures and Dissolved Oxygen in Fairfax Creek

Two loggers were installed in Fairfax Creek, one (FC10) just upstream of dam downstream of 300 Olema Road; the second (FC20), downstream of Scenic Road. The times series for those loggers are shown in Figure 19 and Figure 20, respectively. At both locations, temperatures tended to be relatively high for salmonids. Fairfax Creek has a total barrier to salmonids passage at its mouth. The barrier also causes major flooding in downtown Fairfax; treating both problems is on the agenda for the Ross Valley Watershed Program. It would be prudent to take measures to reduce water temperatures in Fairfax Creek in preparation for the potential return of steelhead.

9: Water Temperatures and Dissolved Oxygen in Sleepy Hollow Creek

One logger was installed in lower Sleepy Hollow Creek (SH20), just downstream of Mountain View Avenue. Data gathered at that location are in Figure 21. For the 2012 season, we were unable to find a secure but accessible location for an upstream logger in Sleepy Hollow Creek.

Figure 17: Time series of temperature and DO recorded by upstream Lansdale loggers

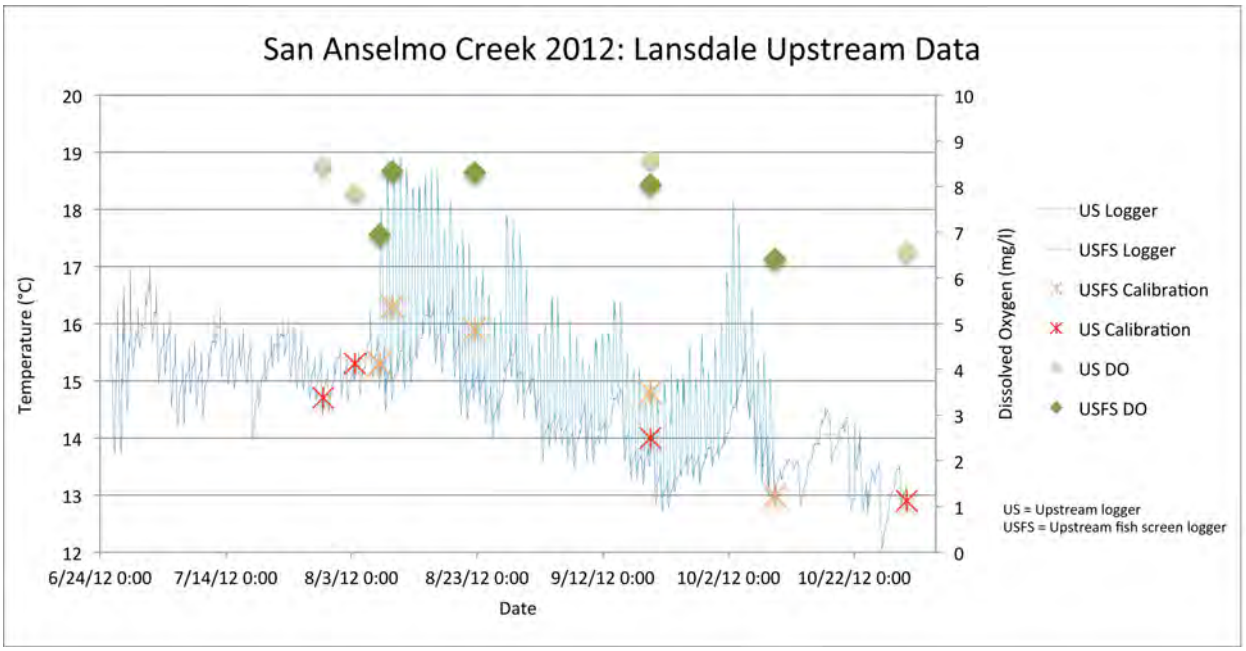


Figure 18: Time series of temperature and DO recorded by downstream Lansdale logger

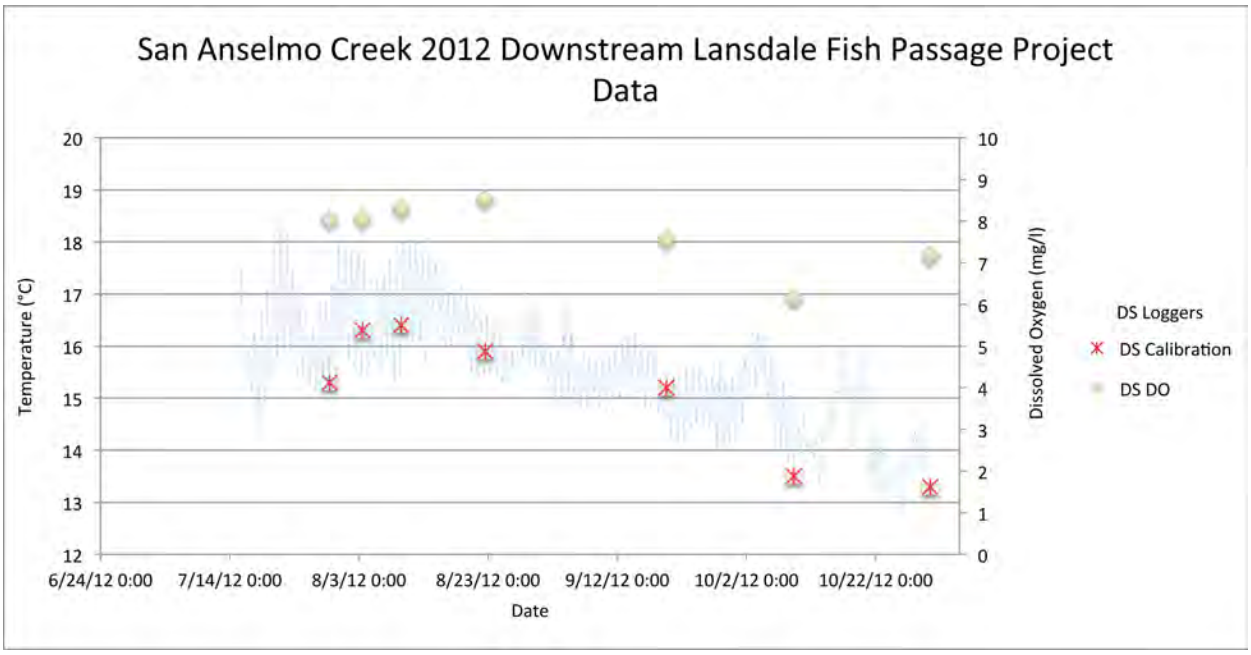


Figure 19: Time series of temperature and DO recorded by logger FC10

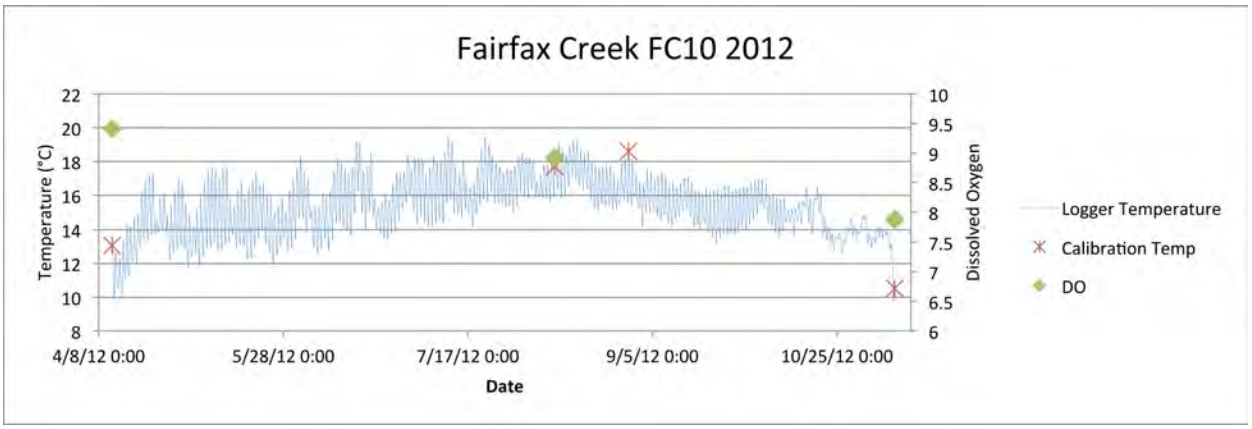


Figure 20: Time series of temperature and DO recorded by logger FC20

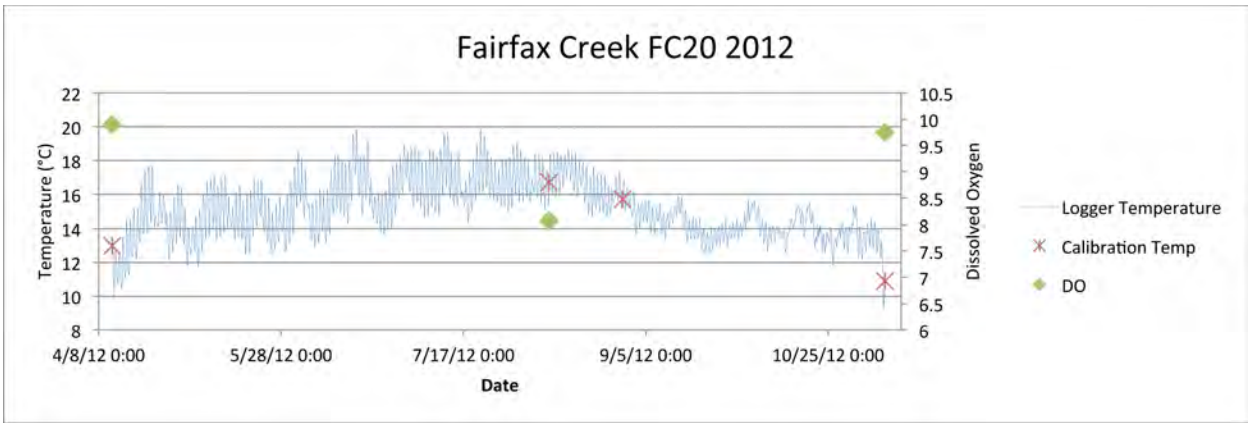
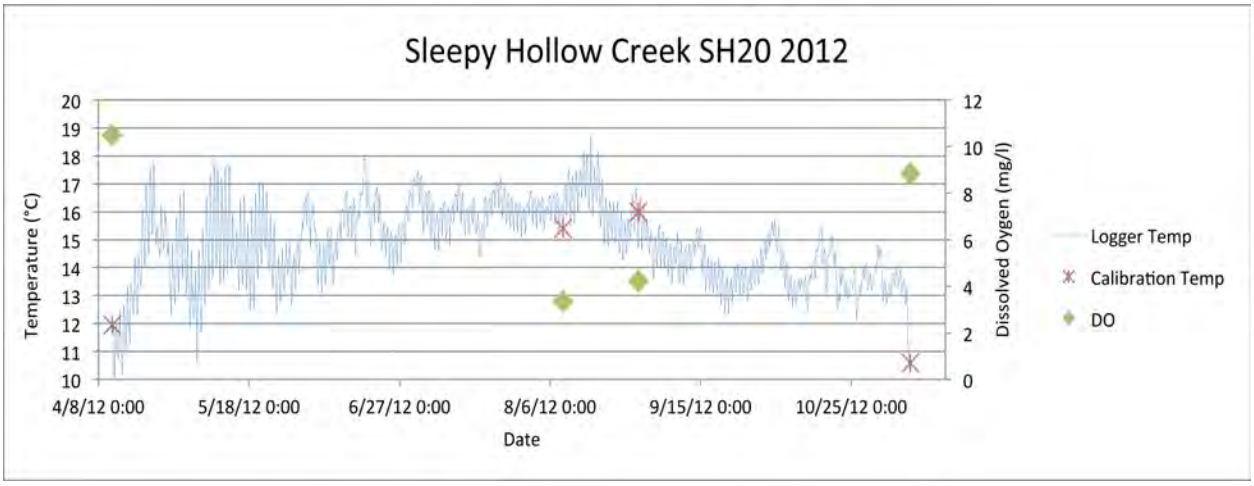


Figure 21: Time series of temperature and DO recorded by logger SH20



Expense Report and Accounting

Wildlife and Fisheries Grant FY 2011-2012
Phoenix Lake/Ross Creek Temperature

Name of Organization:	Friends of Corte Madera Creek Watershed
Address:	P.O. Box 415, Larkspur CA 94977
Program Director:	Sandra Guldman
Telephone Number:	415-456-5052
Total Grant Award:	$1,140
Period Ending:	September 2012

Itemized List of 2012 Expenses	
	Cost
Hardware (cable, swivels, weights, fasteners)	110.31
Onset: HOBO Water Temp Pro v2 Loggers and protective boots(10)	1,320.00
YSI Temperature/DO Probes and Meter	1,529.19
	$ 2,959.50

Total Paid by W&F	$1,140.00
Total Paid by Friends	1,819.50
Total Amount of Reimbursement Requested	0
Funds Remaining in Grant	0

Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and obligations are for the purposes set forth in the services agreement.

Ann Thomas

Signature of Finance Officer

December 27, 2012

Date