

California Regional Water Quality Control Board
North Coast Region

Laguna de Santa Rosa TMDL

Diel Water Quality Monitoring Report - 2011

December 2011

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1.0 INTRODUCTION

The water quality of the Laguna de Santa Rosa (Laguna) has been studied for decades. The State Water Board adopted the Section 303(d) listings of the Laguna in 1976 for high nutrients and low dissolved oxygen (DO) concentrations. Low DO concentrations were the result of inputs of excessive nutrients and organic matter which stimulate photosynthetic growth and subsequently cause depressed DO levels when the algae dies and decays.

Dissolved oxygen concentrations can vary considerably over a 24-hour period (i.e., diel cycle) driven by changes in temperature and photosynthesis. Understanding the dynamics of diel DO requires deployment of continuous monitoring equipment (i.e., DataSondes). These instruments concurrently measure continuous DO, temperature and pH. Diel pH variation is commonly caused by the consumption of dissolved carbonic acid for photosynthesis by aquatic plants and algae. Diel temperature variation affects oxygen saturation potential, aeration, photosynthesis and oxygen demanding processes (Nimick et al., 2011)

2.0 MONITORING QUESTIONS

Since the Section 303(d) listing, North Coast Regional Water Quality Control Board (Water Board) staff and others have intermittently monitored diel water quality in the Laguna watershed (Table 1 and Figure 1). These data have been previously presented in a memorandum to the Laguna TMDL administrative file (Butkus, 2010). Most of these measurements have been collected within the mainstem Laguna. Prior to 2011, no diel measurements had been collected from tributaries in the Laguna Watershed by Regional Water Board staff.

In order to better understand diel DO conditions in tributaries, staff undertook a monitoring effort in 2011. This monitoring was conducted according to companion documents that include the Monitoring Plan (NCRWQCB, 2008a) and Quality Assurance Project Plan (NCRWQCB, 2008b). This monitoring was conducted at new locations within the Laguna watershed. This report serves to document the results of this monitoring.

3.0 DATA COLLECTION

Locations were selected for diel water quality monitoring to cover the range of different landscape conditions within the watershed (Table 2 and Figure 1). The monitoring locations on Mark West Creek, S.F. Santa Rosa Creek, and Copeland Creek were selected to represent watershed headwater conditions. The monitoring locations on Windsor Creek, Santa Rosa Creek, and Paulin Creek represent the alluvial conditions of the Santa Rosa Plain. The location on Blucher Creek was selected to represent the geologically different landscape conditions draining from the western side of the Laguna watershed.

Continuous DO concentration, pH and temperature data were collected during July and August 2011. Assessment of dynamic water quality in the Laguna watershed was made using these data collected at the locations and dates shown in Table 2. Data collected on Data Sonde deployment and retrieval dates were not included in the analysis of diel conditions (i.e., only data collected for a 24-hour period beginning at 00:00/midnight were used).

4.0 RESULTS

Tables were developed presenting several statistical metrics (i.e., mean, maximum, minimum, range) that represent the median value during the measurement period. Tables 3-6 present these descriptive statistics for continuous dissolved oxygen concentration and percent saturation, pH, and temperature data. These data were also compared using continuous data plots (Figures 2-8).

5.0 FINDINGS

All three headwater locations measured (i.e., S.F. Santa Rosa Creek, Mark West Creek, and Copeland Creek) showed good water quality conditions. Dissolved oxygen concentrations always met the water quality objective of 7.0 mg/L found in the Basin Plan (NCRWQCB, 2007). The water temperature also met temperature thresholds for salmonid juvenile non-core rearing of 18°C (USEPA, 2003). Values of pH show a moderately productive system with little diel range. These data indicate that water quality likely supports designated use for headwater reaches of the Laguna watershed.

The tributary locations measured (i.e., Blucher Creek, Paulin Creek, and Windsor Creek) showed relatively poor water quality conditions. Daily minimum dissolved oxygen was well below the water quality objective. The diel range of dissolved oxygen and pH indicate that the low levels are related to a highly productive ecosystem. An unidentified discharge is evident in Blucher

Creek by the near instantaneous drop in dissolved oxygen on August 18-20 (Wednesday – Friday), but not evident on August 21-22 (Saturday & Sunday).

Temperature water quality thresholds measured in the tributary locations were met for adult migration of 20°C, but only Blucher Creek met the use support threshold for salmonid juvenile non-core rearing. The low diel range of temperature in Blucher creek indicates a good riparian canopy, or a local upstream spring source.

Water quality measured in Santa Rosa Creek at Brookwood Avenue show water quality likely supports aquatic life uses. Water quality objectives for dissolved oxygen were met and temperature threshold would support salmon non-core juvenile rearing.

6.0 CITATIONS

Butkus,S. 2010. Water Quality Dynamics within the Laguna de Santa Rosa Watershed. Memorandum to the File: Laguna de Santa Rosa: TMDL Development and Planning dated 25 March 2010. North Coast Regional Water Quality Control Board, Santa Rosa, CA.

NCRWQCB, 2008a. Laguna de Santa Rosa TMDL Monitoring Plan – June 2008. North Coast Regional Water Quality Control Boars, Santa Rosa, CA.

NCRWQCB, 2008b. Laguna de Santa Rosa TMDL Quality Assurance Project Plan – June 2008. North Coast Regional Water Quality Control Boars, Santa Rosa, CA.

NCRWQCB. 2011. Water Quality Control Plan for the North Coast Region. Adopted May 2011. North Coast Regional Water Quality Control Board, Santa Rosa CA.

Nimick, D.A., Gammons, C.H. and S.R. Parker. 2011. Diel biogeochemical processes and their effect on the aqueous chemistry of streams: A review. *Chemical Geology* 283: 3-17.

U.S. Environmental Protection Agency (USEPA). 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Water Quality Standards. Region 10, Seattle, WA. EPA 910-B-03-002. 49pp. Available online at: <<http://www.epa.gov/r10earth/temperature.htm>>. Website accessed on June 23, 2004.

Tables

Table 1. Laguna Monitoring Locations with Diel Data Sonde Measurements (Butkus, 2010)

Location	Survey Years	Total Diel Days Monitored
Stony Point Road	1995, 2001, 2002, 2007	98
Highway 12	1998, 2009	13
Occidental Road	1995, 1998, 2001, 2002, 2008, 2009	121
Guerneville Road	2001, 2002, 2007, 2009	109
Trenton-Healdsburg Road	1995, 1996, 1997, 2001, 2002, 2009	113
Upstream of Laguna confluence with Russian River	2009	13

Table 2. Tributary Monitoring Locations in the Laguna Watershed during 2011

Stream	Location	Monitoring Dates	Total Diel Days Monitored
Santa Rosa Creek, S.F.	Upstream of Azalea Creek	7/12/2011 - 7/25/2011	11
Mark West Creek	Erland Road	7/20/2011 - 7/26/2011	5
Copeland Creek	Lichau Road	7/27/2011 - 8/01-2011	4
Paulin Creek	Marlow Road	8/03/2011 - 8/08/2011	4
Santa Rosa Creek	Brookwood Ave	8/10/2011 - 8/15/2011	4
Blucher Creek	Lone Pine Road	8/17/2011 - 8/22/2011	4
Windsor Creek	Mark West Station Road	8/24/2011 - 8/29/2011	4

Table 3. Dissolved Oxygen Concentration Statistical Metrics
 Values represent the median value during the measurement period

Stream	Dissolved Oxygen (mg/L)			
	Daily Mean	Daily Maximum	Daily Minimum	Diel Range
Santa Rosa Creek, S.F.	9.7	10.1	9.4	0.6
Mark West Creek	8.0	8.4	7.6	0.8
Copeland Creek	9.6	10.1	9.3	0.8
Paulin Creek	6.7	9.6	5.3	4.3
Santa Rosa Creek	8.0	9.7	7.2	2.5
Blucher Creek	4.2	5.0	2.9	2.1
Windsor Creek	5.0	5.4	4.7	0.8

Table 4. Dissolved Oxygen Saturations Statistical Metrics
 Values represent the median value during the measurement period

Stream	Dissolved Oxygen Saturation (%)			
	Daily Mean	Daily Maximum	Daily Minimum	Diel Range
Santa Rosa Creek, S.F.	96	101	95	6
Mark West Creek	81	86	77	8
Copeland Creek	98	103	96	7
Paulin Creek	73	109	55	54
Santa Rosa Creek	83	106	73	33
Blucher Creek	42	50	28	22
Windsor Creek	52	58	49	11

Table 5. Water Temperature Statistical Metrics
 Values represent the median value during the measurement period

Stream	Temperature (°C)			
	Daily Mean	Daily Maximum	Daily Minimum	Diel Range
Santa Rosa Creek, S.F.	15.1	16.4	14.2	2.6
Mark West Creek	16.1	17.2	15.1	2.2
Copeland Creek	16.3	18.0	15.3	2.7
Paulin Creek	18.9	21.9	17.2	4.8
Santa Rosa Creek	17.3	19.7	16.1	3.7
Blucher Creek	14.9	15.7	14.5	1.2
Windsor Creek	17.1	18.5	16.2	2.3

Table 6. pH Statistical Metrics
 Values represent the median value during the measurement period

Stream	pH (s.u.)			
	Daily Mean	Daily Maximum	Daily Minimum	Diel Range
Santa Rosa Creek, S.F.	8.3	8.4	8.3	0.1
Mark West Creek	8.0	8.1	7.9	0.2
Copeland Creek	8.1	8.2	8.0	0.2
Paulin Creek	7.7	7.8	7.5	0.3
Santa Rosa Creek	7.8	8.0	7.7	0.3
Blucher Creek	6.9	6.9	6.8	0.1
Windsor Creek	7.5	7.5	7.4	0.1

Figures

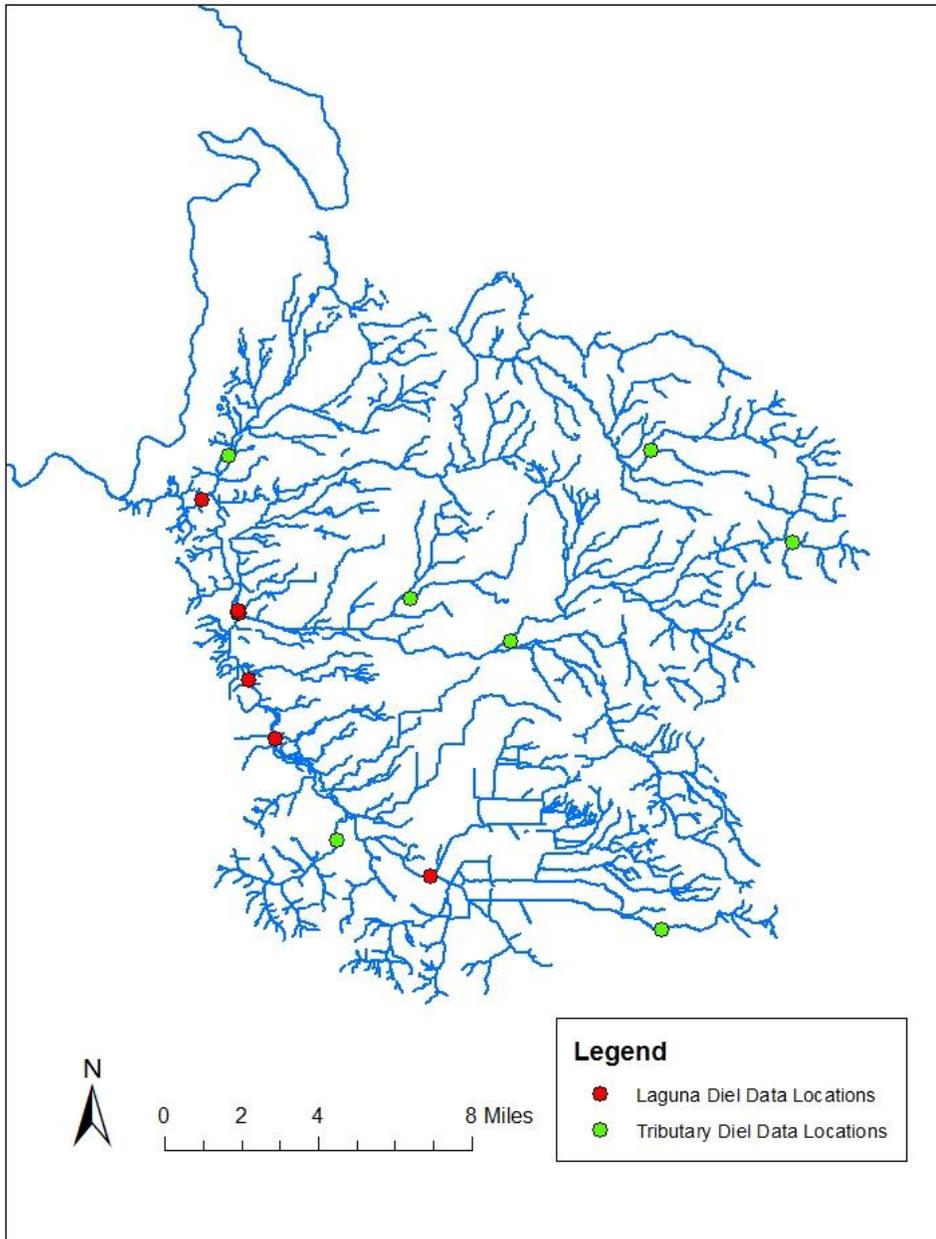


Figure 1 Historical Laguna and Current Tributary Diel Data Sonde Measurement Locations

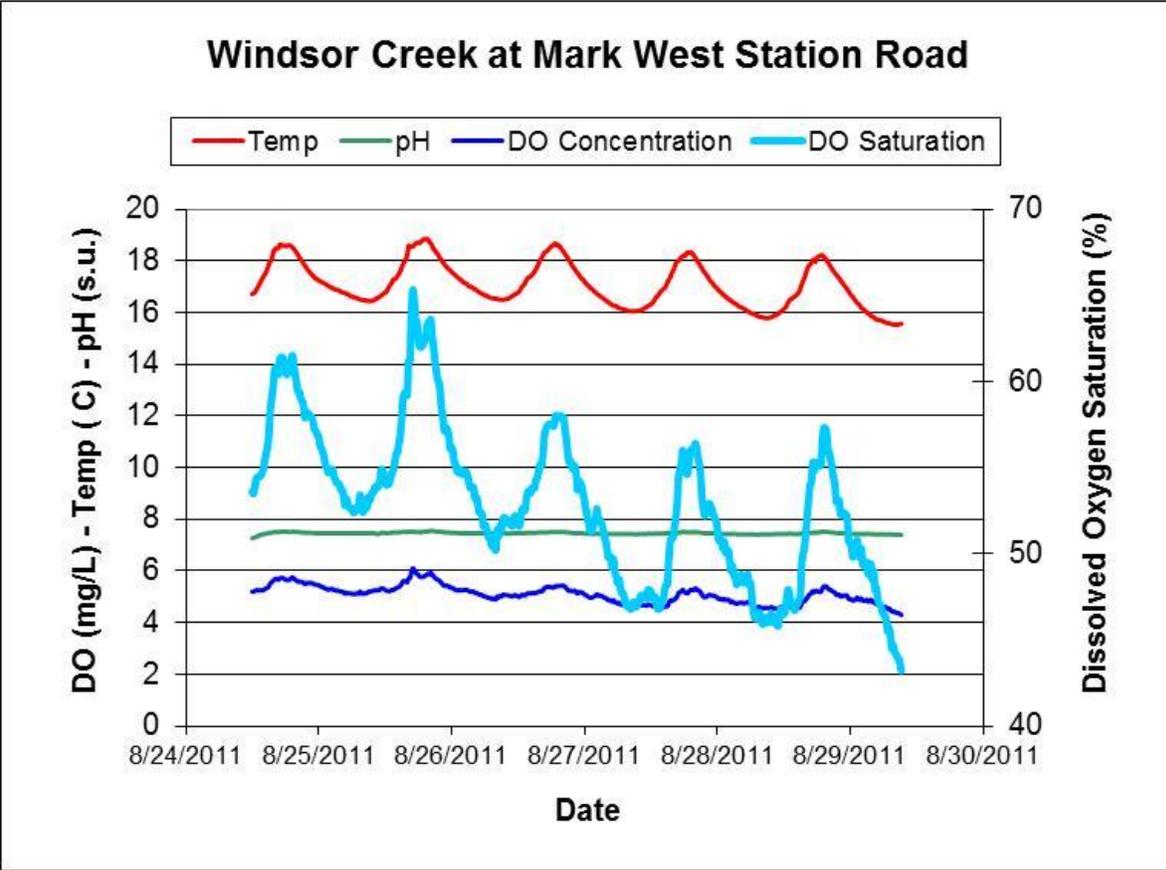


Figure 2. Diel Data Sonde Measurement collected from Windsor Creek at Mark West Station Road

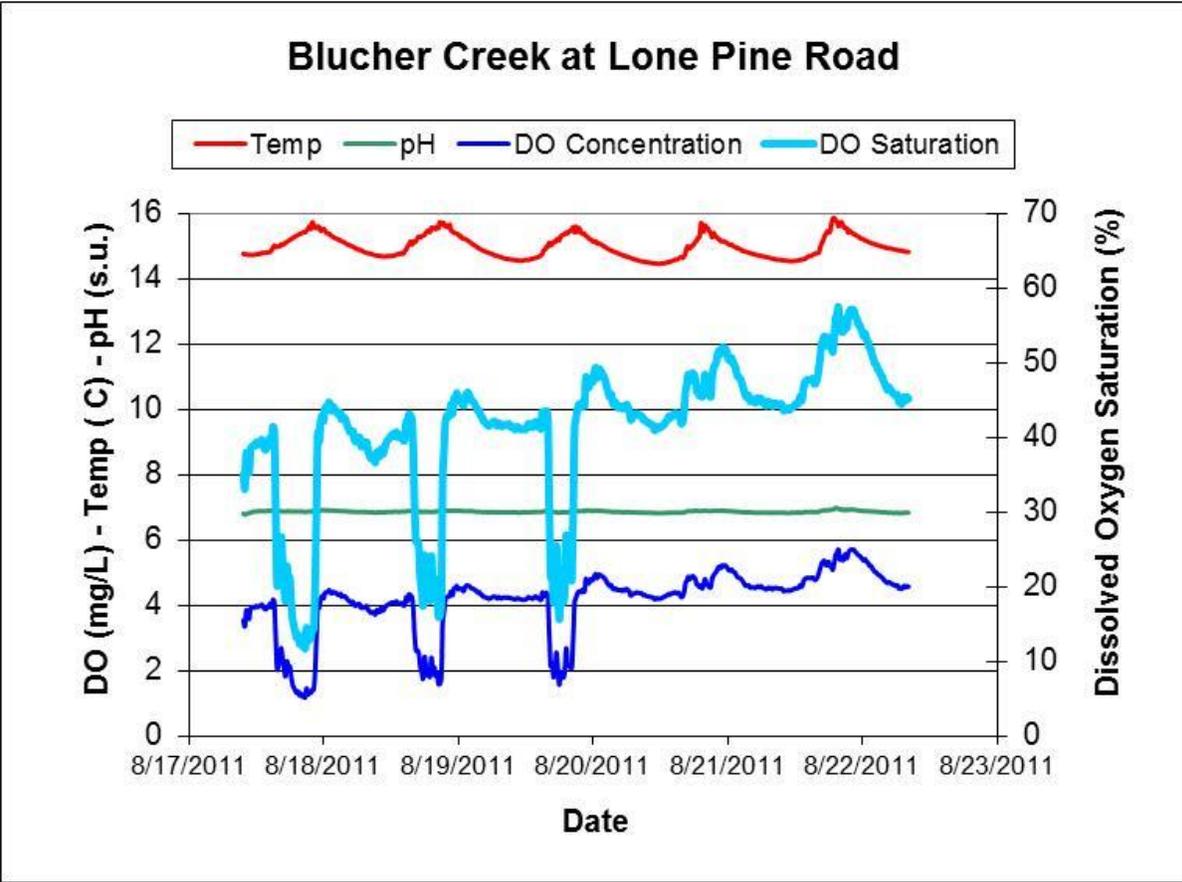


Figure 3. Diel Data Sonde Measurement collected from Blucher Creek at Lone Pine Road Road

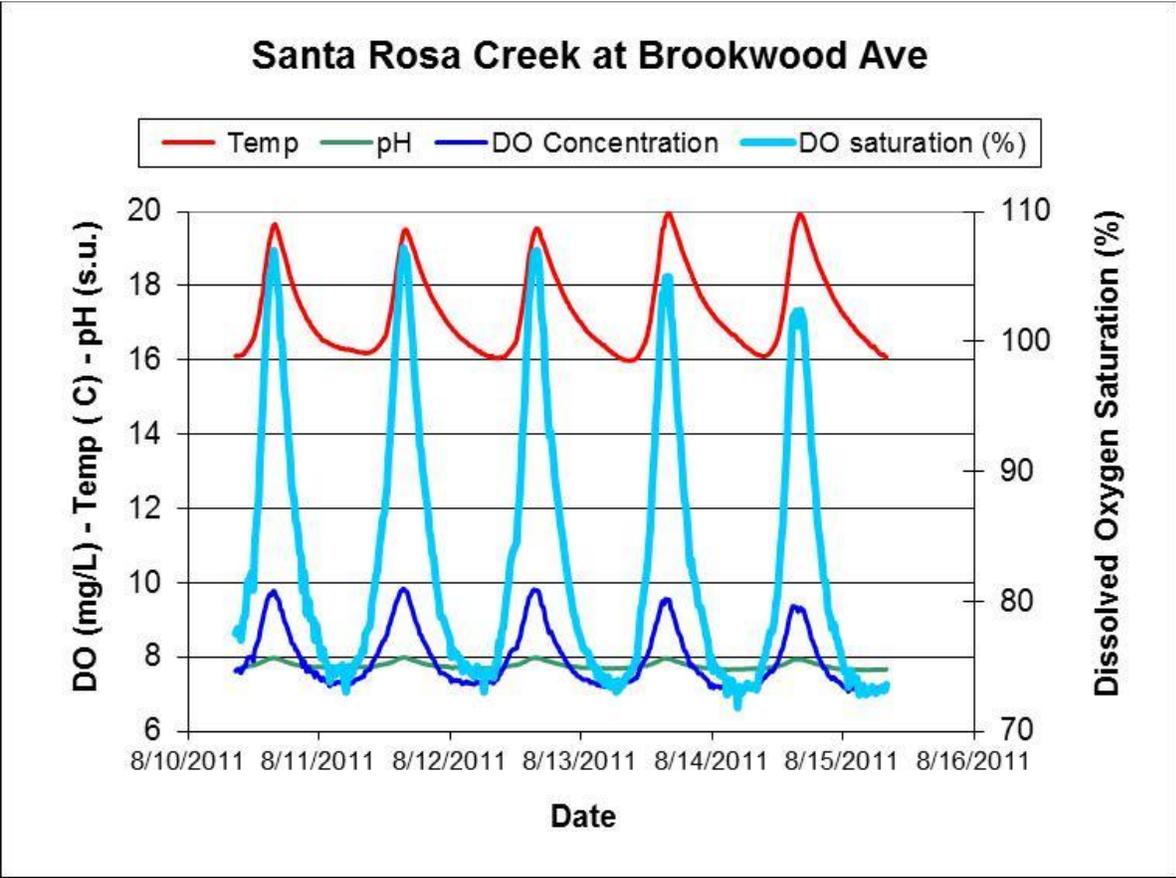


Figure 4. Diel Data Sonde Measurement collected from Santa Rosa Creek at Brookwood Ave

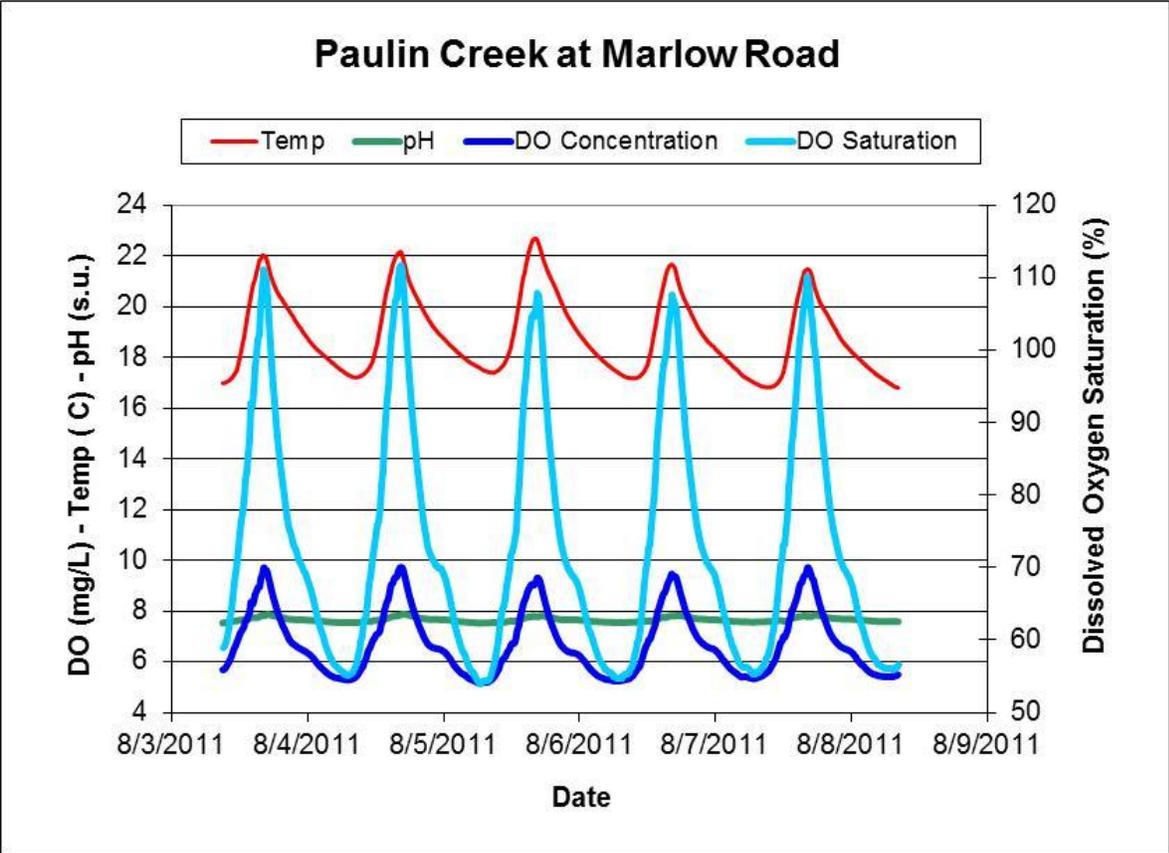


Figure 5. Diel Data Sonde Measurement collected from Paulin Creek at Marlow Road

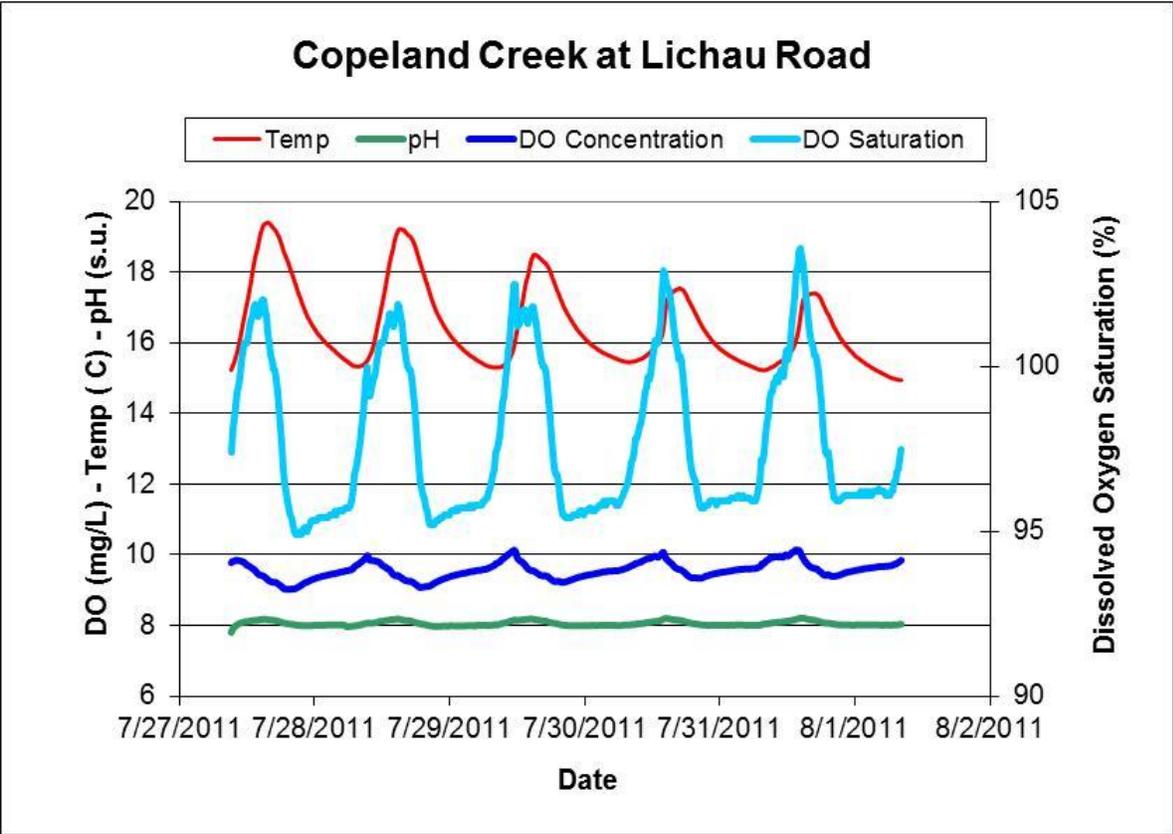


Figure 6. Diel Data Sonde Measurement collected from Copeland Creek at Lichau Road

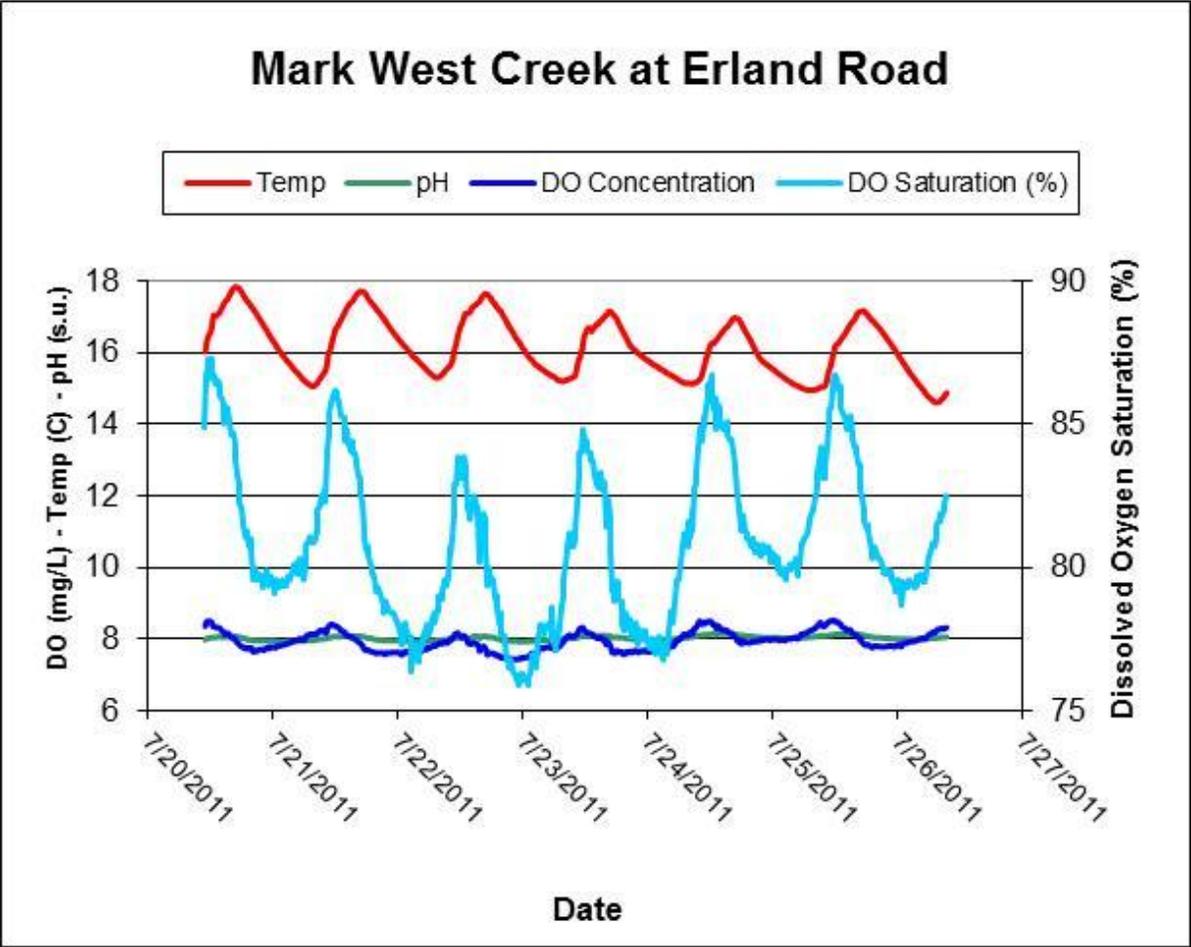


Figure 7. Diel Data Sonde Measurement collected from Mark West Creek at Erland Road

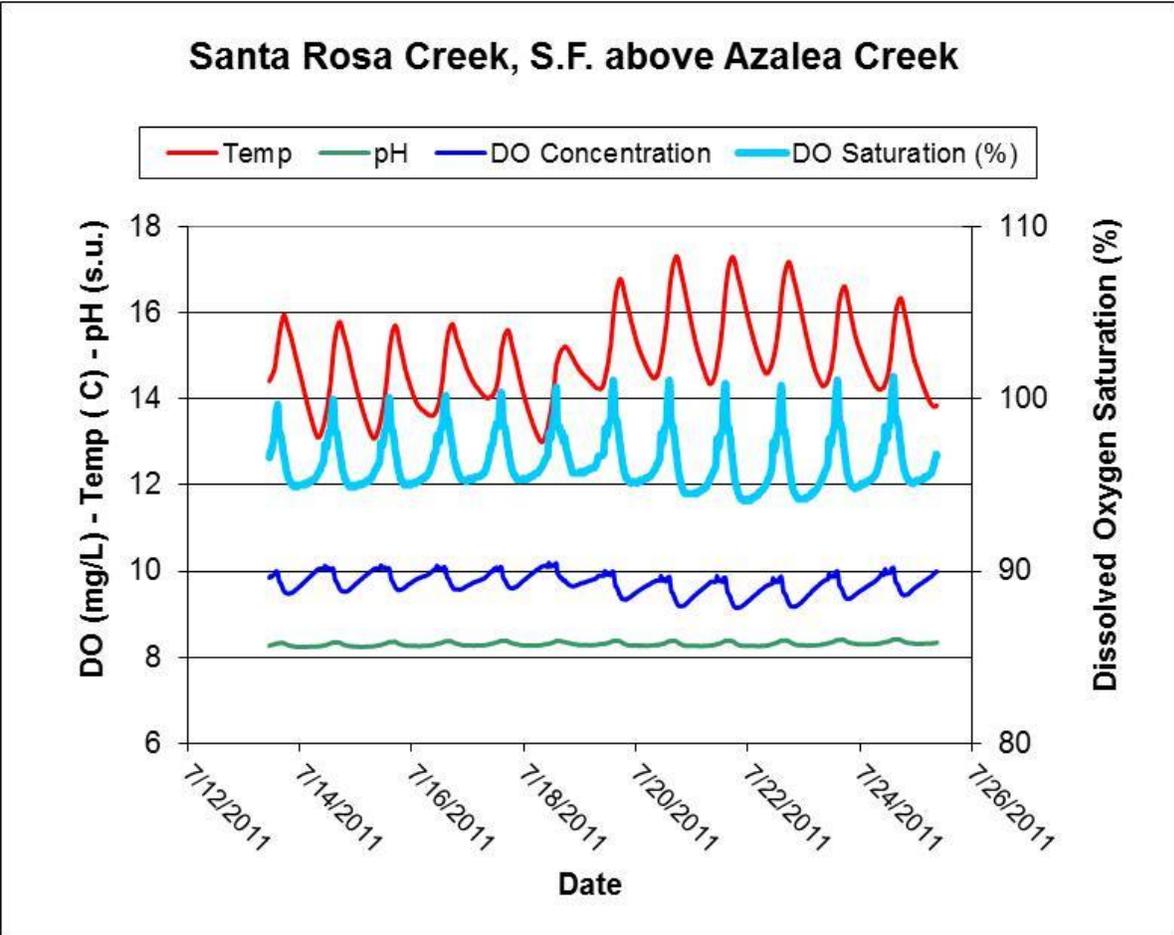


Figure 8. Diel Data Sonde Measurement collected from S.F. Santa Rosa Creek upstream of Azalea Creek