El Dorado Hydroelectric Project
FERC Project No. 184

2010 Water Quality Monitoring Report

EL DORADO IRRIGATION DISTRICT
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March 2011

1.0 Introduction

The El Dorado Irrigation District developed a water quality monitoring plan (Plan; EID 2007) to satisfy the water quality monitoring requirements as required by conditions of the Federal Energy Regulatory Commission (FERC) license for the El Dorado Hydroelectric Project (Project 184)[1]. The monitoring plan was designed to provide information regarding overall water quality within the vicinity of Project 184 (Project), identify potential water quality problems related to the Project operations and where the Project can control such factors, and develop resource measures for the protection, mitigation, and enhancement of water quality.

The Plan requires water quality data to be collected eight times per year during the first three monitoring years. This report summarizes the results of the 2010 water quality monitoring effort. The data collected under this monitoring plan was compiled and distributed electronically to the Forest Service (FS), State Water Resources Control Board (SWRCB), and the Project 184 Ecological Resources Committee (ERC) on January 31, 2011, as required by the Plan.

2.0 Sampling Locations

The following sampling locations are identified in the Plan (EID, 2007) and depicted in Figure 1:

Echo Creek below Echo Lake Dam (WQ1)
Pyramid Creek below Lake Aloha Dam (WQ2)
Caples Creek below Caples Lake Dam (WQ3)
Silver Fork American River below Silver Lake Dam (WQ4)
South Fork American River upstream of Kyburz Diversion Dam (WQ5)
South Fork American River downstream of Kyburz Diversion Dam (WQ6)
Carpenter Creek above Carpenter Creek Diversion Dam (WQ7)
Carpenter Creek below Carpenter Creek Diversion Dam (WQ8)
No Name Creek above No Name Creek Diversion Dam (WQ9)
No Name Creek below No Name Creek Diversion Dam (WQ10)
Alder Creek above of Alder Creek Diversion Dam (WQ11)
Alder Creek below of Alder Creek Diversion Dam (WQ12)
Mill Creek above Mill Creek Diversion Dam (WQ13)

[1] Section 7 of the El Dorado Hydroelectric Project Relicensing Settlement Agreement, U.S. Forest Service 4(e) License Condition No. 37, and the California State Water Resources Control Board Section 401 Clean Water Act Water Quality Certification Condition No. 15

Mill Creek below Mill Creek Diversion Dam (WQ14)
Bull Creek above Bull Creek Diversion Dam (WQ15)
Bull Creek below Bull Creek Diversion Dam (WQ16)
Ogilby Creek above Ogilby Creek Diversion Dam (WQ17)
Ogilby Creek below Ogilby Creek Diversion Dam (WQ18)
Esmeralda Creek above Esmeralda Creek Diversion Dam (WQ19)
Esmeralda Creek below Esmeralda Creek Diversion Dam(WQ20)

The FS, SWRCB, Project 184 ERC, and FERC approved a one-year variance to discontinue monitoring at Mill Creek (T15 and T16) and Carpenter Creek (T23 and T24) in 2010 since the diversion structures on these creeks are not operational. Therefore, no water quality monitoring was conducted at these sites in 2010.

3.0 Collection

In-situ and analytical water quality monitoring were performed in 2010, as required by the Plan. Date, time, site location, weather, and in-situ water quality data were recorded on a standard form and later transcribed to electronic format in a Microsoft Excel spreadsheet. GPS coordinates and photographs were taken at each sampling site to document conditions at the time of sampling. Sampling occurred over an eight-month period during March, May, June, July, August, September, first storm of the season, and December. E. coli samples were collect five times per month from May through September and captured days with high recreational periods (i.e. holiday weekends).

Temperature, dissolved oxygen, conductivity, and pH were measured in the field at each location using an YSI 556: Handheld Multi-Probe Meter. The YSI meter was calibrated in a laboratory per manufacturer's instruction prior to each field visit. During each sampling period, a back-up meter was also calibrated and ready for use. Turbidity was measured with a Hach handheld turbidity meter. The meter was calibrated prior to each sampling period per manufacturer's specifications.

Water samples were collected at each location. Two 100 ml bottles were used for the total and fecal coliform tests, and 1 four-liter container was used for testing copper, aluminum, TSS, Alkalinity, Hardness, and Nitrate levels at each sampling site. California Laboratory Services (CLS) in Rancho Cordova, California, a state certified laboratory, analyzed water samples collected for this effort. All the samples were analyzed pursuant to the United States Environmental Protection Agency (USEPA), California Department of Public Health, or Environmental Laboratory Accreditation

Program (ELAP) approved methodologies and results were certified to be in compliance both technically and for completeness. All samples met the appropriate hold times.

4.0 Parameters and Results

Temperature

Average, minimum, and maximum temperatures recorded during the 2010 monitoring effort at each water quality monitoring site are reported in Table 1. Graphs depicting *in situ* parameters measured at each monitoring site are provided in Figures 2 - 10.

Table 1. Average, minimum, and maximum water temperatures (°C) at each monitoring site

Site	AVG	MIN	MAX
WQ1	9.6	0.9	20.8
WQ2	14.0	8.6	19.0
WQ3	6.2	1.9	12.7
WQ4	9.5	1.0	15.9
WQ5	8.3	2.6	14.0
WQ6	9.4	2.2	15.8
WQ9	8.9	4.4	11.8
WQ10	9.4	4.3	13.2
WQ11	9.8	3.0	16.6
WQ12	11.4	3.0	18.0
WQ15	9.6	4.1	14.3
WQ16	9.7	3.9	13.5
WQ17	8.9	5.6	14.8
WQ18	10.1	4.4	13.3
WQ19	9.5	4.9	13.4
WQ20	10.4	4.0	14.3

Water temperatures measured at each water quality monitoring site in 2010 were suitable for trout and other coldwater species throughout the study period. A detailed evaluation of water temperatures in the stream reaches within the vicinity of the Project is provided in the Project 184 2010 Water Temperature Monitoring Report (EID 2011).

Dissolved Oxygen

Average, minimum, and maximum dissolved oxygen (DO) concentration recorded during the 2010 monitoring effort at each water quality monitoring site are reported in Table 2. Graphs depicting *in situ* parameters measured at each monitoring site are provided in Figures 2 - 10.

Table 2. Average, minimum, and maximum DO concentrations (mg/L) at each monitoring site

Site	AVG	MIN	MAX
WQ1	11.2	7.5	15.1
WQ2	11.6	7.5	15.5
WQ3	12.9	11.1	15.0
WQ4	11.1	7.6	16.5
WQ5	13.9	10.8	18.2
WQ6	13.6	11.6	17.6
WQ9	13.2	11.8	16.6
WQ10	13.0	10.8	14.7
WQ11	13.7	11.7	18.1
WQ12	13.2	10.3	16.6
WQ15	14.8	10.3	18.6
WQ16	13.5	11.6	18.3
WQ17	14.3	11.6	18.4
WQ18	13.1	11.6	18.1
WQ19	14.2	10.4	18.9
WQ20	14.0	12.2	19.3

Basin Plan objectives state "The DO concentrations shall not be reduced below the following minimum levels at any time…waters designated COLD 7.0 mg/L (RWQCB-5, 2005). DO ranged from 7.5 mg/L at Echo Creek (WQ01 and WQ2) to 19.3 mg/L in Esmeralda Creek below the diversion dam (WQ20). The average DO concentration throughout the entire project area in 2010 was 13.2 mg/L. DO levels remained consistent at each location throughout the sampling period and DO concentrations never fell below the Basin Plan COLD designated beneficial uses objective.

Conductivity

Average, minimum, and maximum conductivity levels recorded during the 2010 monitoring effort at each water quality monitoring site are reported in Table 3. Graphs depicting *in situ* parameters measured at each monitoring site are provided in Figures 2 - 10.

Table 3. Average, minimum, and maximum conductivity levels (uS/cm³) at each monitoring site

Site	AVG	MIN	MAX
WQ1	10	6	17
WQ2	8	2	24
WQ3	21	18	25
WQ4	15	12	20
WQ5	40	17	61
WQ6	33	22	42
WQ9	131	67	188
WQ10	118	67	164
WQ11	35	29	45
WQ12	37	30	53
WQ15	71	51	100
WQ16	84	59	125
WQ17	52	43	69
WQ18	57	46	65
WQ19	53	47	61
WQ20	38	36	42

Currently there are no criteria or water quality objective for conductivity within the American River watershed. Conductivity levels ranged from 2 uS/cm³ at Echo Creek (WQ2) to 188 uS/cm³ in No Name Creek above the diversion dam (WQ9). The average conductivity level throughout the entire project area in 2010 was 51 uS/cm³.

pH

Average, minimum, and maximum pH levels recorded during the 2010 monitoring effort at each water quality monitoring site are reported in Table 4. Graphs depicting *in situ* parameters measured at each monitoring site are provided in Figures 2 - 10.

Table 4. Average, minimum, and maximum pH levels at each monitoring site

Site	AVG	MIN*	MAX
WQ1	4.8	3.3	6.8
WQ2	4.0	6.2	8.3
WQ3	6.6	4.8	8.4
WQ4	6.6	6.2	7.0
WQ5	6.3	4.9	7.7
WQ6	6.2	4.4	7.0
WQ9	6.6	3.7	7.5
WQ10	7.1	6.6	7.8
WQ11	6.8	5.2	7.6
WQ12	6.1	5.1	7.8
WQ15	7.1	6.0	7.9
WQ16	7.1	6.1	7.8
WQ17	7.1	5.9	7.5
WQ18	7.1	6.2	7.6
WQ19	7.0	6.1	7.6
WQ20	7.3	5.8	7.9

* 17 measurements were < 3 pH units and excluded from this analysis

The Basin Plan states that "pH shall not be depressed below 6.5 nor raised above 8.5 and that changes in normal ambient pH levels shall not exceed 0.5 in fresh waters with designated COLD beneficial uses" (RWQCB-5, 2005). pH levels ranged from 3.3 at Echo Creek (WQ1) to 8.4 at Caples Creek below Caples Lake Dam (WQ3). The average pH throughout the entire project area in 2010 was 6.7. pH was below 8.5 at all locations during all sampling events throughout the year.

Turbidity

Average, minimum, and maximum turbidity levels recorded during the 2010 monitoring effort at each water quality monitoring site are reported in Table 5. Turbidity measurements measured at each monitoring site in 2010 are presented with *in situ* parameters in Figures 2 - 10.

Table 5. Average, minimum, and maximum turbidity levels (NTUs) at each monitoring site

Site	AVG	MIN	MAX
WQ1	0.4	0	0.8
WQ2	0.3	0	0.6
WQ3	1.0	0.8	1.3
WQ4	0.8	0	1.2
WQ5	0.7	0	2.4
WQ6	0.9	0	3.6
WQ9	1.3	0	3.1
WQ10	3.6	1.8	7.1
WQ11	0.5	0	1.5
WQ12	0.5	0	1.7
WQ15	1.7	0.6	7.4
WQ16	0.5	0	1.7
WQ17	1.5	0.5	4.0
WQ18	1.3	0.7	2.6
WQ19	2.7	0.7	7.5
WQ20	2.0	0	4.1

* 0 denotes a non-detect result from laboratory analysis

The Basin Plan states, "where natural turbidity is between 0 and 5 NTUs, increases shall not exceed 1 NTU. Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent" (RWQCB-5, 2005). All turbidity measurements were generally low throughout the study area (average =1.22 NTUs). Only three turbidity measurements were greater than 5 NTUs: 7.4 NTUs at Bull Creek above the diversion on December 7, 2010; 7.5 NTUs at Esmeralda Creek above the diversion dam on October 25, 2010; and 7.1 NTUs at No Name Creek below diversion. Two of these measurements greater than 5 NTUs were recorded at sites upstream of the diversion dams. These measurements also coincided with rain events (6.5 inches of precipitation at Pacific House weather station on October 23-24, 2010; 1 inch precipitation at Pacific House weather station on December 6, 2010).

A comparison of turbidity measurements above and below diversion dams found a total of seven occurrences where turbidity downstream of the diversion was greater than 1 NTU of the value measured above the diversion dam. On October 25, 2010, the turbidity level measured in SFAR below Kyburz Diversion Dam (WQ6) was 3.6 NTUs compared to 2.4 NTUs (Δ = 1.2 NTUs) measured in SFAR above Kyburz Diversion Dam (WQ5). This measurement coincided with a significant rain event (6.5 inches of precipitation at Pacific House weather station on October 23-24, 2010. On June 25, 2010, the turbidity level measured in Ogilby Creek below the diversion dam (WQ18) was 2.6 NTUs compared to 0.5 NTUs (Δ = 2.1 NTUs) measured in Ogilby Creek above the diversion dam (WQ17). This difference may be attributed to spring runoff conditions.

The remaining five occurrences where turbidity downstream of the diversion was greater than 1 NTU of the value measured above the diversion dam were measured in No Name Creek (WQ9 and WQ10). Table 6 provides the turbidity levels measured above and below the diversion dam for each of these events.

Table 6. Turbidity levels (NTUs) in No Name Creek above and below the diversion when turbidity levels below the diversion were > 1 NTU of the value measured above the diversion dam

Date	WQ9	WQ10	Difference
Jul 29, 2010	1.4	5.1	+ 3.7
Aug 26, 2010	0	2.4	+ 2.4
Sept 23, 2010	1.0	2.7	+ 1.7
Oct 25, 2010	0.9	5.6	+ 4.7
Dec 7, 2010	3.1	7.1	+ 4.0

Two of these measurements coincided with rain events (6.5 inches of precipitation at Pacific House weather station on October 23-24, 2010; 1 inch precipitation at Pacific House weather station on December 6, 2010). As discussed in the 2008 Project 184 Water Quality Monitoring Report (EID 2009), a cabin owner has placed a decorative water wheel in the middle of No Name Creek upstream of the designated sampling location (WQ10). The water wheel causes an increase in sediment and organic matter to move downstream.

Total Suspended Sediments

Total Suspended Sediment (TSS) concentrations measured at all sample sites in 2010 are plotted in Figure 11.

The Basin Plan has a narrative objective that states, "Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses" (RWQCB-5, 2005). TSS measurements were extremely low throughout the project area. Of 122 samples analyzed, 102 samples had TSS levels that were not detectable in laboratory analysis. The highest TSS level was 20 mg/L measured at South Fork American River downstream of Kyburz Diversion Dam (WQ6) on October 25, 2010.

Alkalinity

Alkalinity levels measured at all sample sites in 2010 are plotted in Figure 12.

There are currently no Basin Plan objectives for alkalinity. The U.S. Environmental Protection Agency recommends ambient water quality criteria for alkalinity to protect freshwater aquatic life to be measured as a continuous concentration 4-day average expressed as a total recoverable. The aquatic life 4-day average concentration for alkalinity is 20 mg/L. The recommendation also states that "20 mg/L is a minimum concentration except where natural concentrations are less (Water Quality Goals, 2008).

The frequency of monitoring in the approved plan does not provide for a direct relationship to the recommended average concentration. The average alkalinity throughout the Project boundary was 24 mg/L. The sampling locations with the highest concentrations of alkalinity were No Name Creek (WQ-09 and WQ10 and Bull Creek (WQ-15 and WQ16) Average, minimum, and maximum alkalinity concentrations measured at No Name Creek and Bull Creek are presented in Table 7.

Table 7. Average, minimum, and maximum alkalinity concentrations (mg/L) measured at No Name Creek and Bull Creek

Site	AVG	MIN	MAX
WQ9	64	34	84
WQ10	57	33	69
WQ15	33	23	29
WQ16	38	30	49

There was no appreciable difference between the alkalinity measurements upstream or downstream of the diversions at No Name and Bull Creeks. The higher alkalinity concentrations measured at these sites is attributed to calcium carbonate (CaCO3) rich soil that present under these waters (USDA/NRCS, 2008).

Hardness (Calcium Carbonate)

Hardness levels measured at all sample sites in 2010 are plotted in Figure 13.

There is currently no Basin Plan objective for hardness. The sampling locations with the highest hardness value were No Name Creek (WQ9 and WQ10; range = 29 – 89 mg/L) and Bull Creek (WQ15 and WQ16; range 21 – 50 mg/L). The geology at these locations contains large quantities of calcium carbonate that naturally leach into the streams (USDA/NRCS, 2008) producing higher hardness (and alkalinity) concentrations at these locations. The average hardness for the entire project area is 19 mg/L.

Nitrate (Nitrate plus Nitrite)

Nitrate levels measured at all sample sites in 2010 are plotted in Figure 14.

There are currently no Basin Plan objectives for nitrate. The EPA recommends ambient water quality criteria for non-cancer health effects and the California and Federal primary contaminated levels in drinking water to be 10 mg/L (Water Quality Goals, 2008). The highest nitrate value of 0.11 mg/L was measured at Caples Creek (WQ-03).

Of 122 samples analyzed, 82 samples had nitrate levels that were not detectable in laboratory analysis. The nitrate levels were extremely low throughout the project area.

Copper

There is no specific Basin Plan objective for copper; however, the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed bays, and Estuaries of California (SIP, 2005), and the California Toxics Rule (CTR, 2000), provides a formula for deciphering a one-hour total recoverable and/or dissolved copper limit based on its hardness value. This standard has been incorporated by adoption into the Basin Plan. Therefore, the lower the hardness value, the lower the available copper is in the water (greater copper concentration can be allowed due to limited availability of copper in the water table), and the greater the hardness value, the lower the copper concentration must be (more available dissolved copper can affect aquatic life). Ninety-eight percent of the copper results meet the CTR criteria. Pyramid Creek (WQ02) exceeded the copper criteria in July 2010, and Bull Creek below the diversion dam (WQ16) exceeded in March 2010. All other copper levels were below the SIP/CTR 1-hour average total recoverable and dissolved maximum criteria concentrations (Table 8).

Aluminum

Aluminum concentrations measured at all sample sites in 2010 are plotted in Figure 15.

There are currently no Basin Plan objectives for aluminum. The U.S. Environmental Protection Agency recommends ambient water quality criteria for freshwater aquatic life expressed at a maximum concentration 1-hour average to be 750 ug/L (Water Quality Goals, 2008). All samples collected in 2010 were below this criterion.

E. coli

E. coli concentrations measured at all sample sites in 2010 are plotted in Figure 16.

The FS, SWRCB, ERC, and FERC approved a variance from the Plan to utilize Escherichia coli (E. coli) as the bacterial monitoring constituent in lieu of fecal and total coliform testing for the 2010 monitoring effort. There Basin Plan currently does not contain objectives for E. coli; however, the following water quality objective for bacteria is proposed as an amendment to the Basin Plan: "In all waters designated for contact recreation (REC-1), the E. coli concentration, based on a minimum of not less than five samples equally spaced over a 30 day period, shall not exceed a geometric mean of 126/100 ml and shall not exceed 235 per 100ml in any single sample." These criteria were identified in the approved variance to be used to evaluate the bacterial results for this monitoring effort.

Only three samples of the 426 (0.7%) collected in 2010 exceeded the single sample criteria (>235 MPN/100 ml). A sample collected at SFAR below Kyburz (WQ6) on August 4, 2010 had an E. coli concentration of 490 MPN/100 ml; however, the geometric mean for samples collected at the same site between July 29 and August 26 (n=5) was 17 MPN/100 ml. A sample collected at Esmeralda Creek above diversion (WQ19) on August 13, 2010 had an E. coli concentration of 350 MPN/100 ml; however, the geometric mean for samples collected at the same site between August 31 and September 9 (n=5) was 84 MPN/100 ml. A sample collected at Alder Creek above diversion (WQ11) had an E. coli concentration of 280 MPN/100 ml on October 25, 2010. Although a geometric mean analysis could not be conducted to evaluate this measurement because measurements from five additional samples collected within 30 days at this site were not available, follow-up samples were collected at both Alder Creek above diversion (WQ11) and Alder Creek below diversion (WQ12) on November 5, 2010, to determine if elevated E. coli concentrations were present. These samples (n=3) all had very low E. coli concentrations (WQ11: n=2 @ 8 MPN/100 ml; WQ12 n=1 @ 2 MPN/100ml).

5.0 Conclusions

Very low pH values (< 3) were recorded for 17 of 128 measurements. Background levels of the upper elevation waters show a naturally low pH. Research suggests that low pH levels at higher elevations, may reflect the influence of acidic snowmelt events due to increase in air temperature, as well as intense solar radiation causing snow melt (Howell and Springer, 1989). However, low pH values were measured throughout the sampling period indicating that they may also be associated with a malfunctioning probe on the YSI meter. Therefore, alternative methods for evaluating the cause of low pH values are warranted during the 2012 monitoring effort.

Measurements for *in-situ* parameters did not vary above and below the diversion dams along each stream reach and provide normal distributions across the sampling locations based on stream flow elevation and time of year. Laboratory-measured analytical parameters also did not vary in the stream reaches above and below the diversion dams. Project operations did not show any measureable increase or decrease water quality parameters in almost all cases. The high alkalinity levels measured upstream and downstream of diversions at WQ09, WQ10, WQ15, and WQ-16 are caused by the natural background chemistry of the geologic soils. The NRCS web soil survey shows a solid layer of calcium carbonate under these streams. Therefore, project operations do not affect alkalinity levels in the stream reaches.

The water quality constituent copper was exceeded two times during 2010 monitoring effort. The first occurrence was located at Pyramid Creek and may be associated with high flows during spring runoff. The second occurrence was located at Bull Creek (WQ16), which may be attributed to runoff associated with a rain event (0.4 inches of precipitation at Pacific House weather station on March 25, 2010).

Except for the few items discussed above, water quality in the project area met all applicable Basin Plan objectives and other criteria during the 2010 monitoring program. Therefore, project operations did not seem to affect water quality in the stream reaches within the vicinity of the Project.

6.0 Recommendations

Redundancy for pH monitoring

The District recommends utilizing additional monitoring tools and/or methods (e.g. handheld pH meters in addition to multimeter probe) during the 2012 monitoring effort in order to evaluate whether the cause of low pH values are related to site conditions. sampling equipment/methodology, or a combination thereof.

Sample Sites to be removed

There are no functional diversion structures at Mill Creek (WQ13 & WQ14) and Carpenter Creek (WQ7 & WQ8); therefore, the District recommends removing these two sites from the next monitoring effort in 2012.

Bacterial methodology

The District recommends utilizing Escherichia coli (E. coli) as the bacterial monitoring constituent in lieu of fecal and total coliform testing for the 2012 monitoring effort. E. coli is: 1) more accurate indicator of potential human health and safety hazards, 2) the preferred indicator of fecal contamination in recreational freshwater sources, and 3) the most cost effective indicator to analyze in the laboratory.

7.0 Literature Cited

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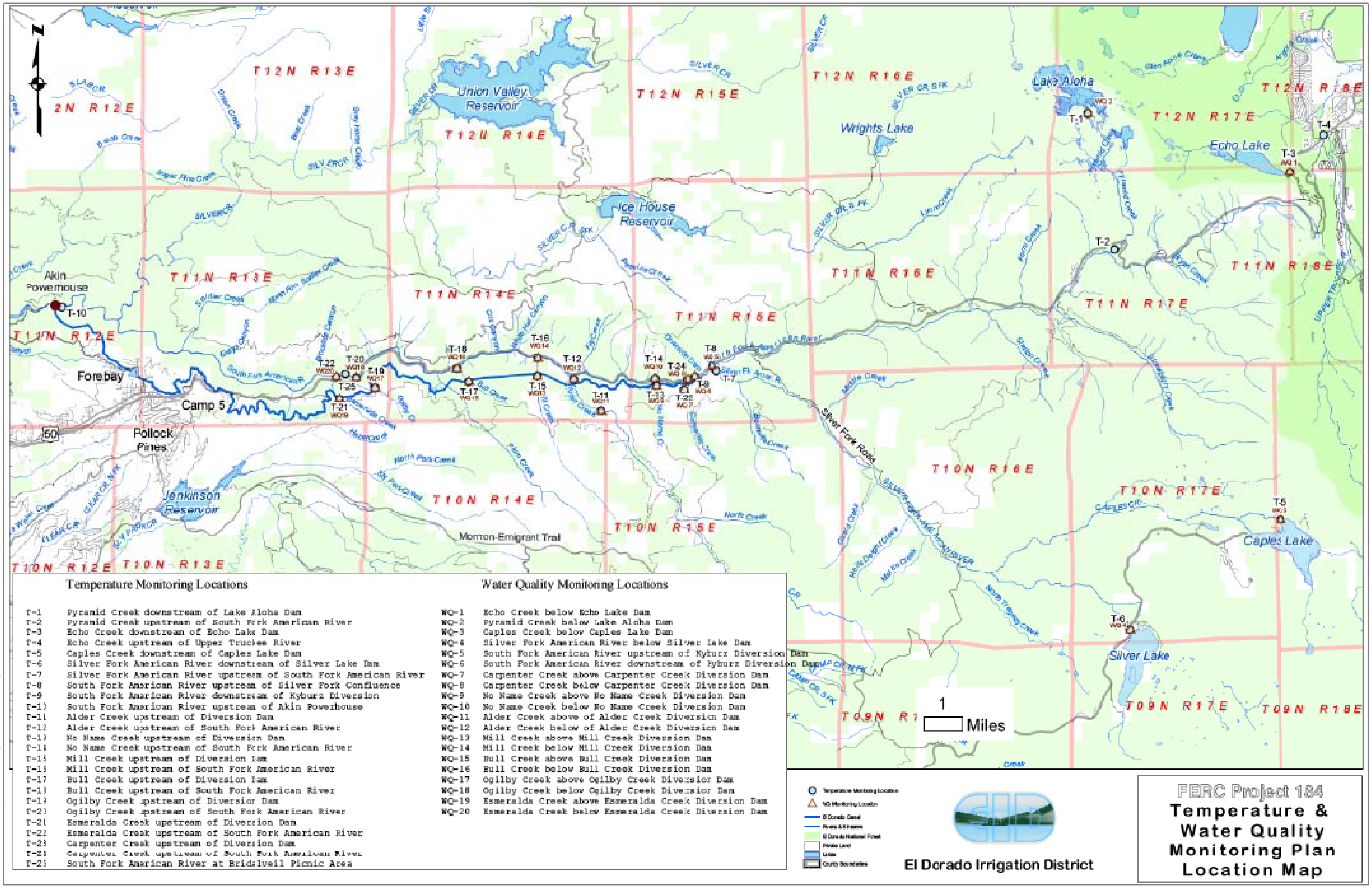

Figure 1. Water Quality Monitoring Sites

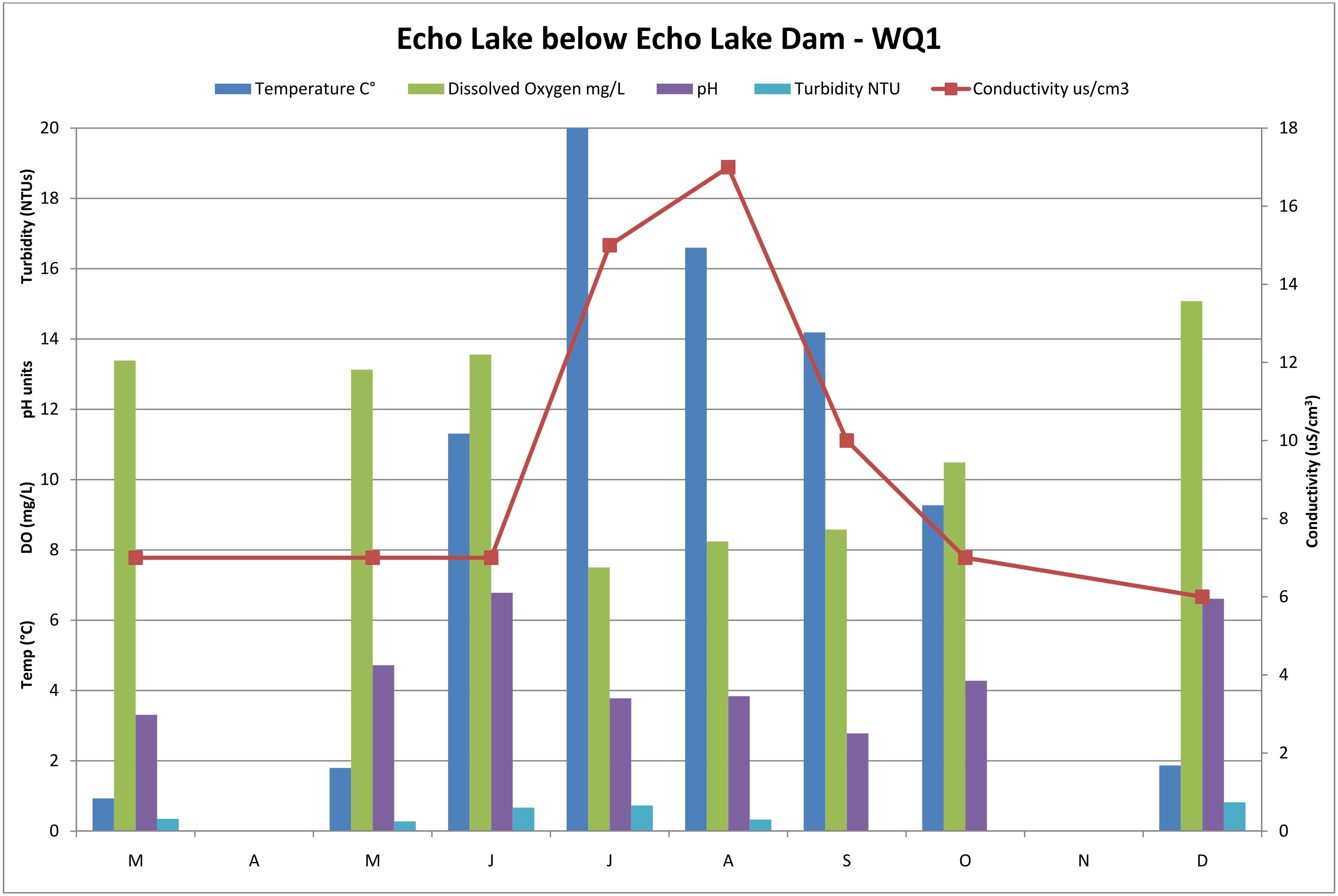

Figure 2. Water temperature, DO, pH, turbidity, and conductivity measured at Echo Lake below Echo Lake Dam - WQ1 in 2010

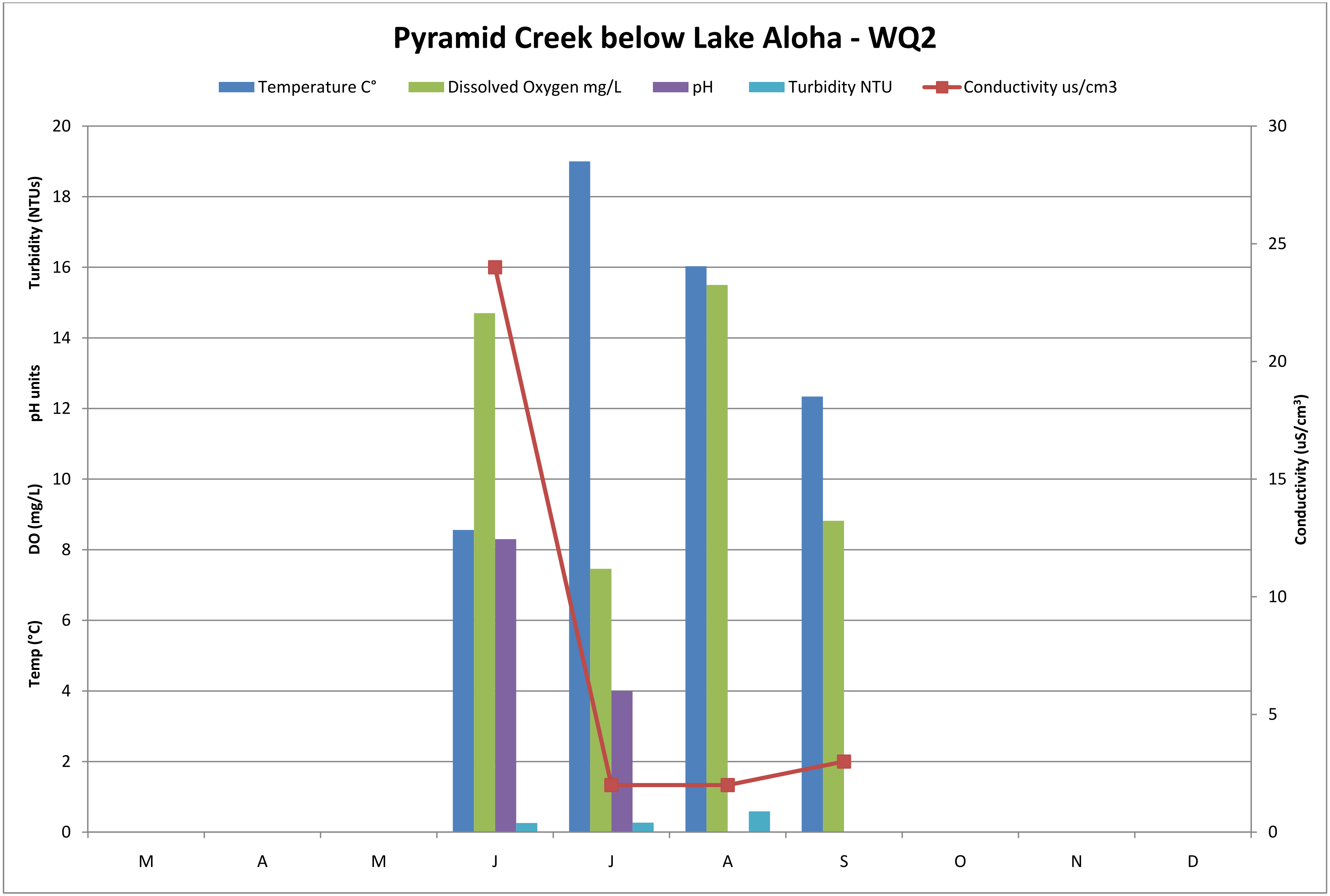

Figure 3. Water temperature, DO, pH, turbidity, and conductivity measured at Pyramid Creek below Lake Aloha - WQ2 in 2010

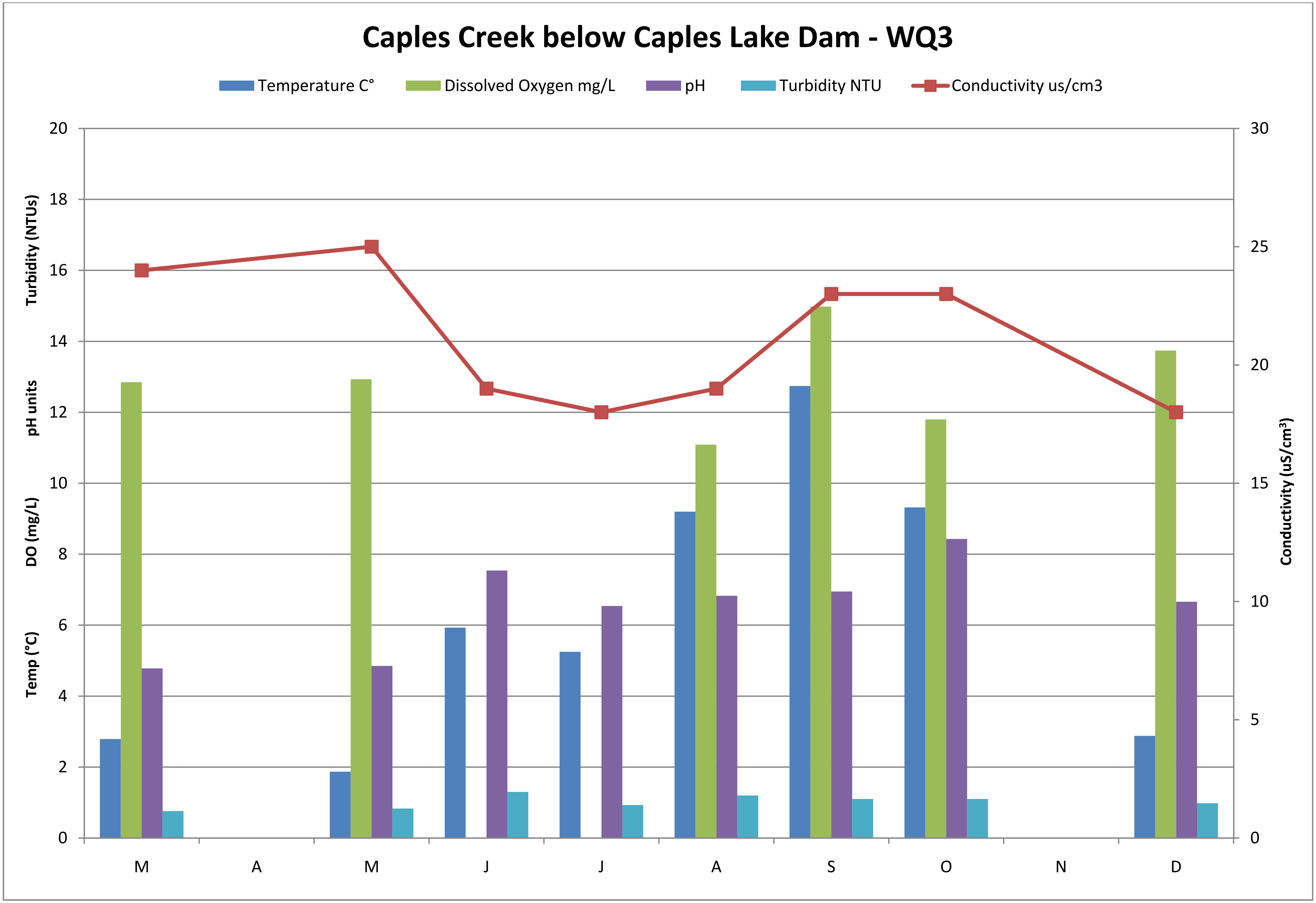

Figure 3. Water temperature, DO, pH, turbidity, and conductivity measured at Caples Creek below Caples Lake Dam – WQ3 in 2010

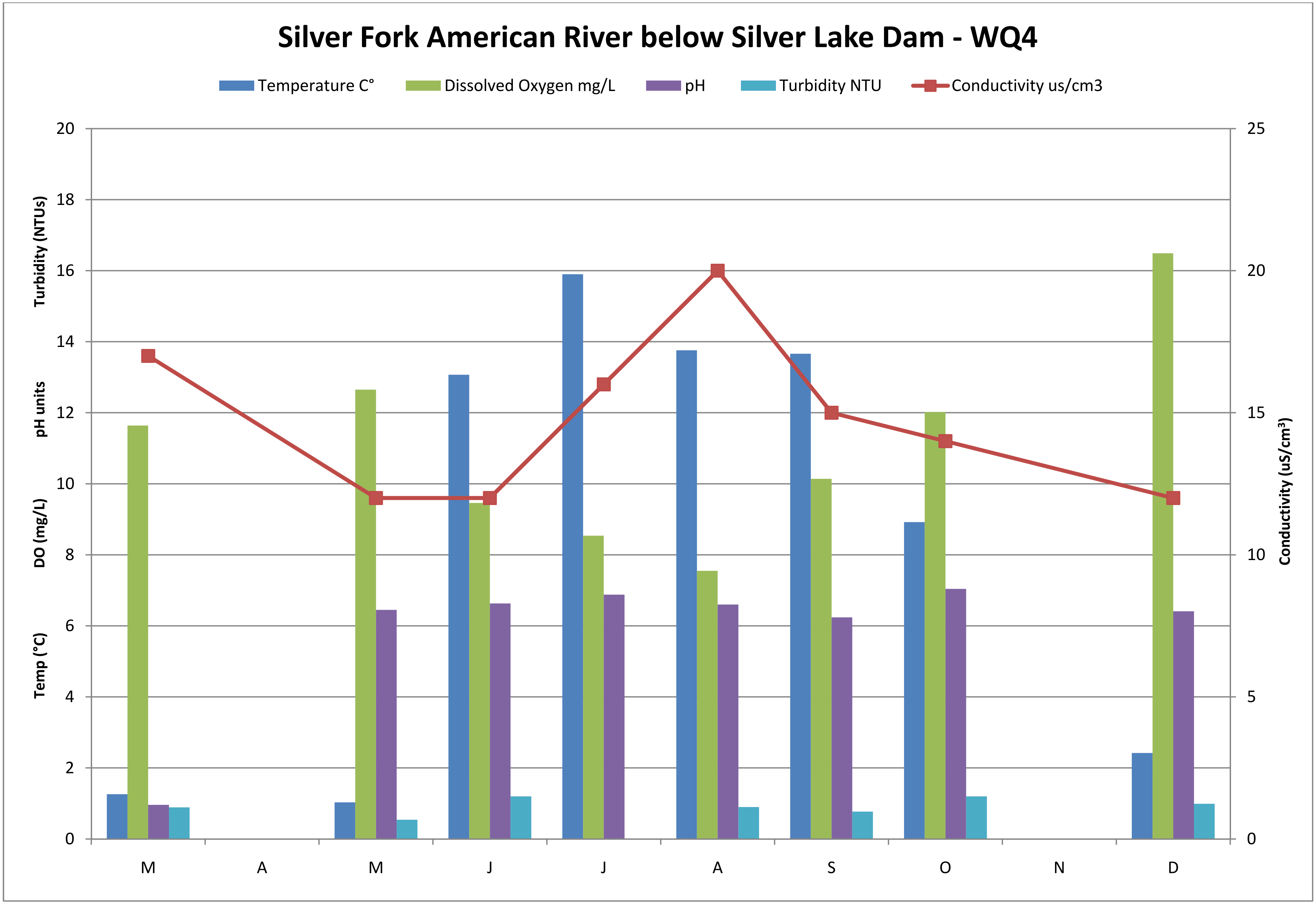

Figure 4. Water temperature, DO, pH, turbidity, and conductivity measured at Silver Fork American River below Silver Lake Dam - WQ4 in 2010

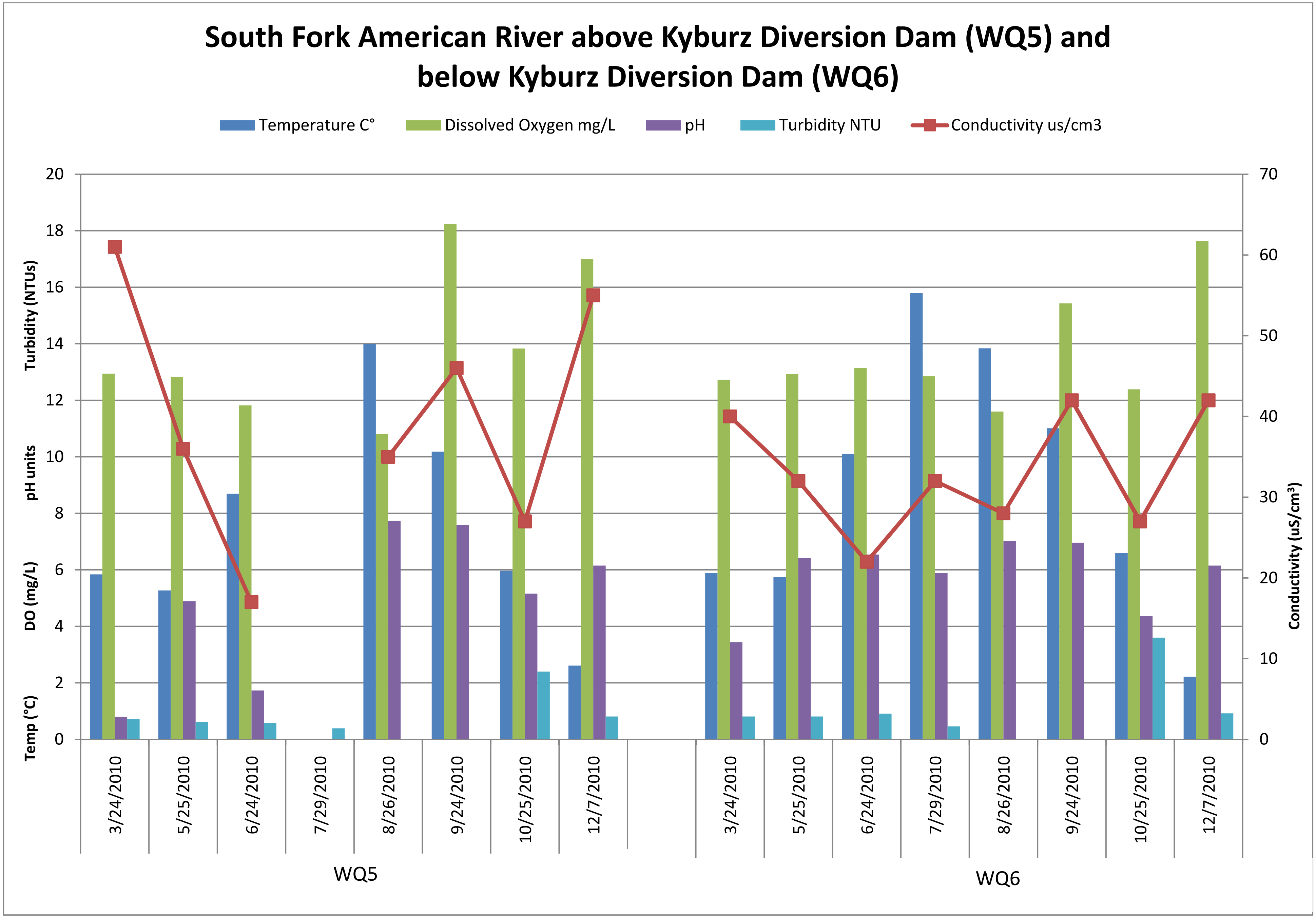

Figure 5. Water temperature, DO, pH, turbidity, and conductivity measured at SFAR above (WQ5) and below (WQ6) Kyburz Diversion Dam in 2010

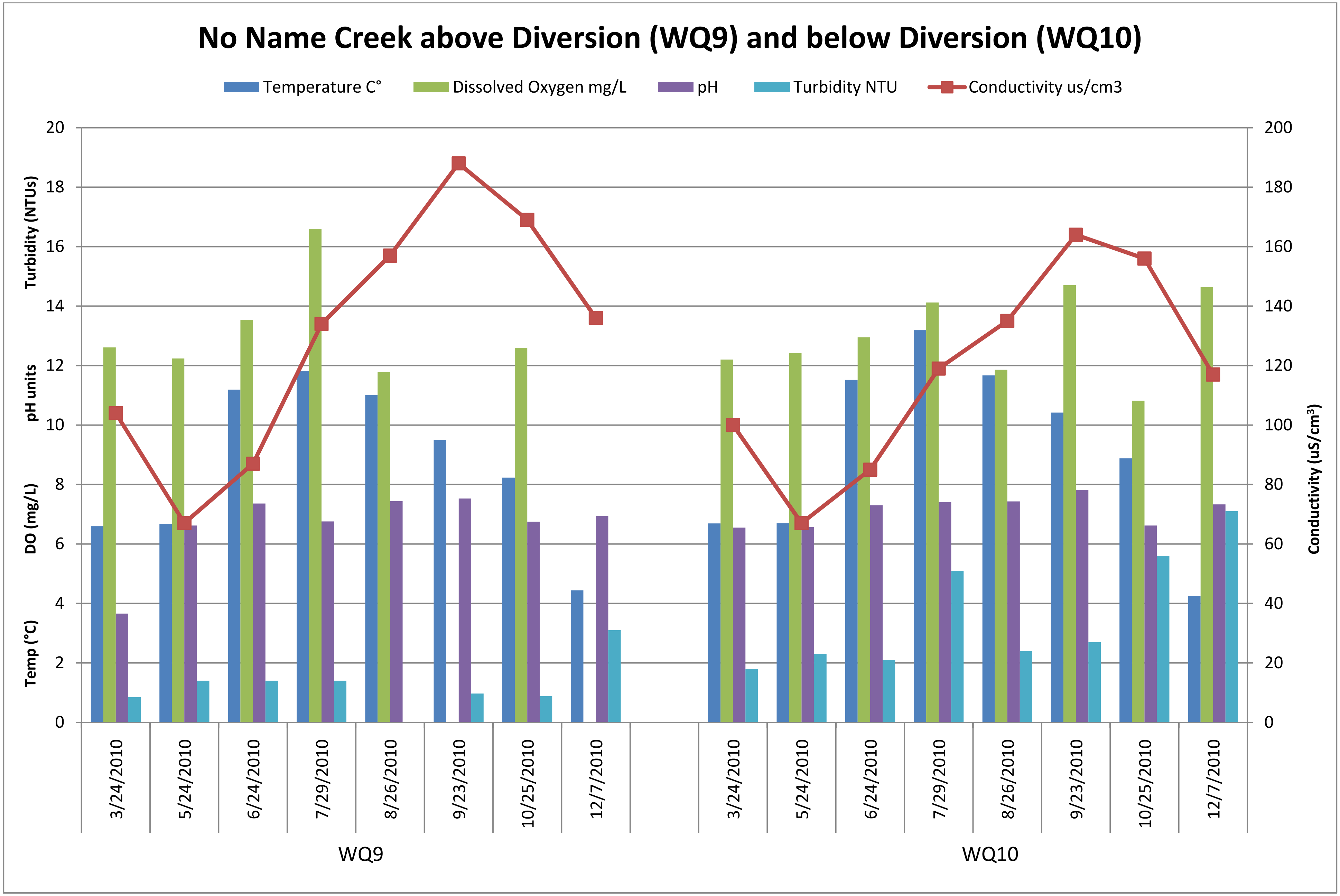

Figure 6. Water temperature, DO, pH, turbidity, and conductivity measured at No Name Creek above (WQ9) and below (WQ10) diversion in 2010

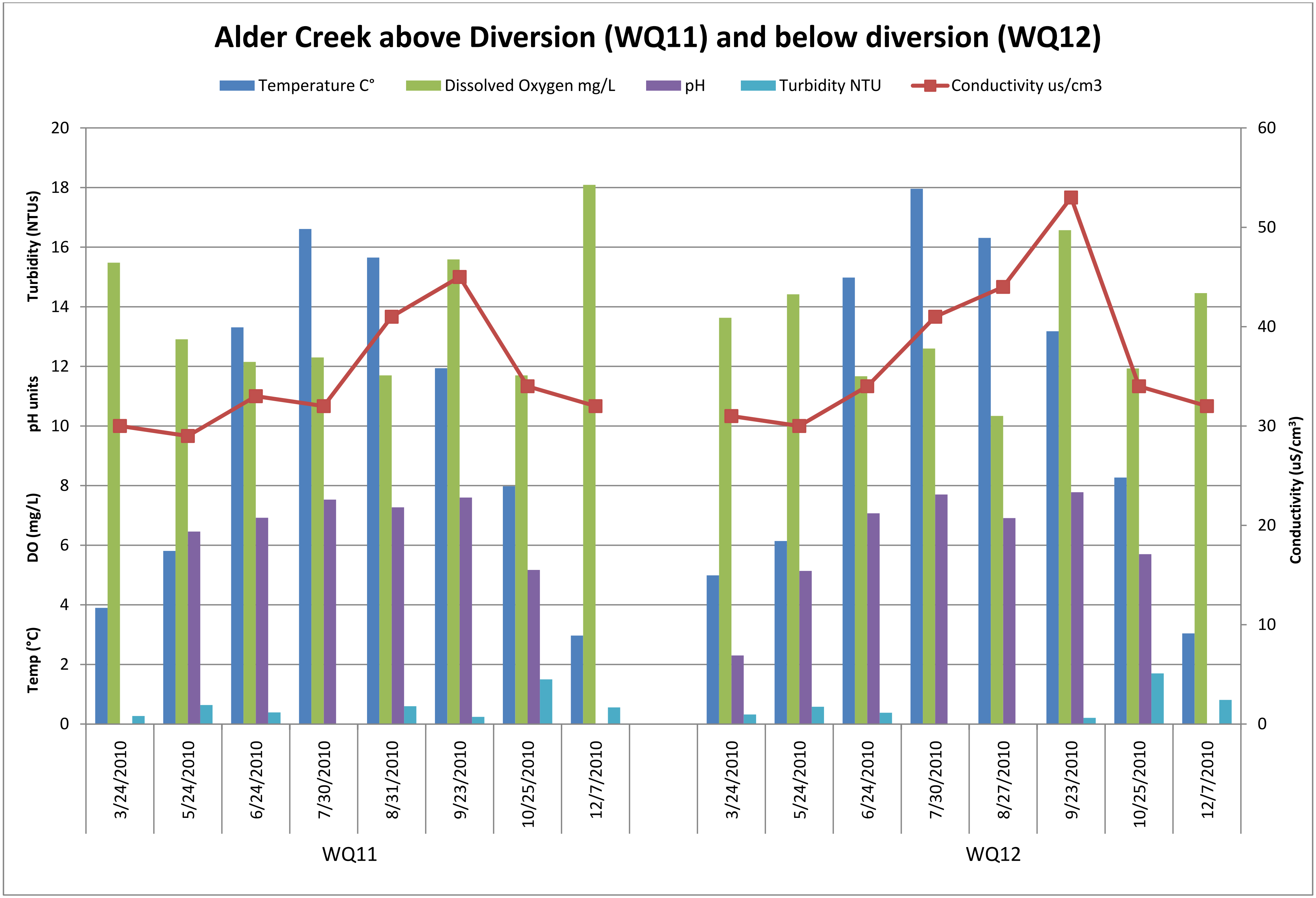

Figure 7. Water temperature, DO, pH, turbidity, and conductivity measured at Alder Creek above (WQ11) and below (WQ12) diversion in 2010

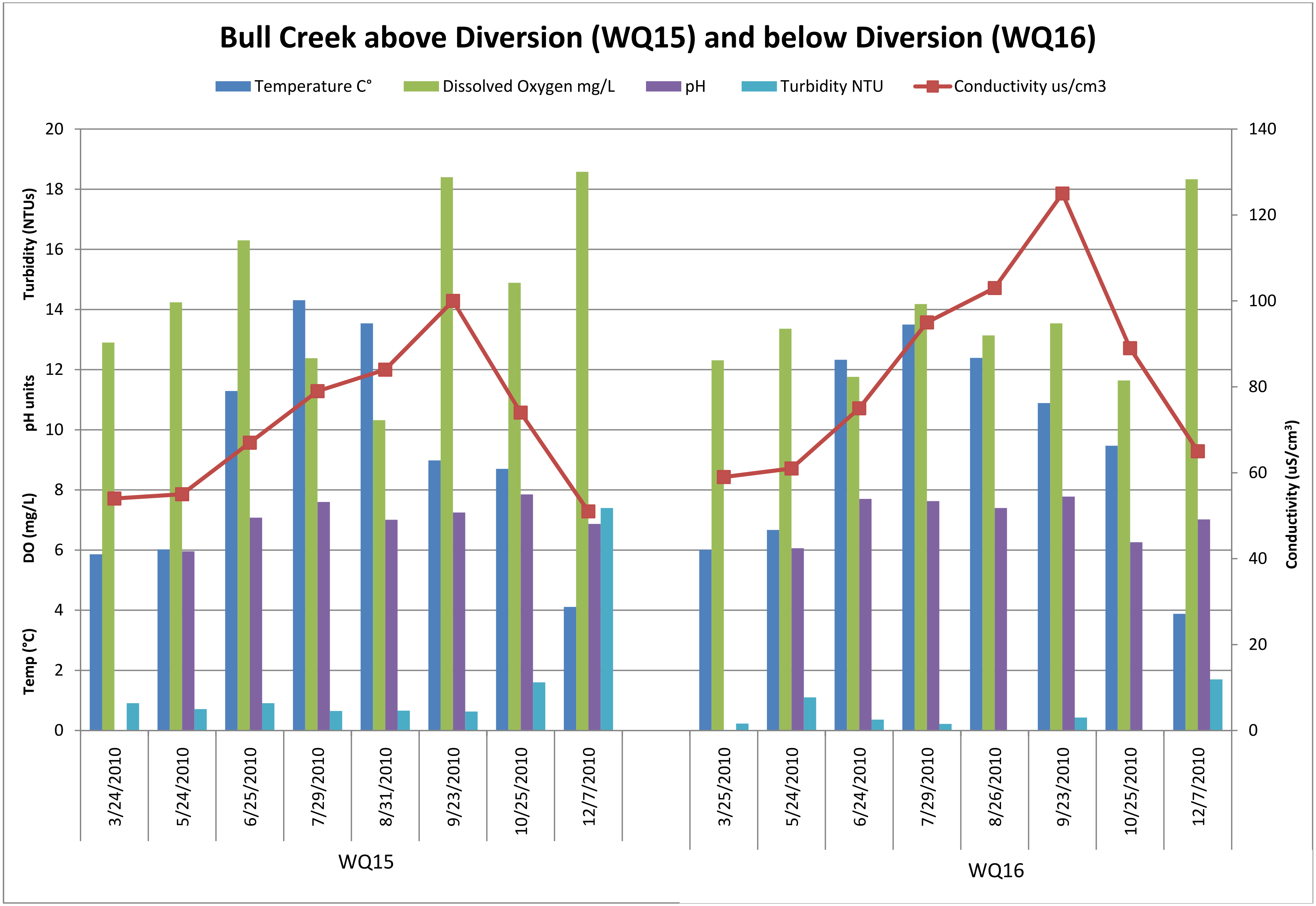

Figure 8. Water temperature, DO, pH, turbidity, and conductivity measured at Bull Creek above (WQ15) and below (WQ16) diversion in 2010

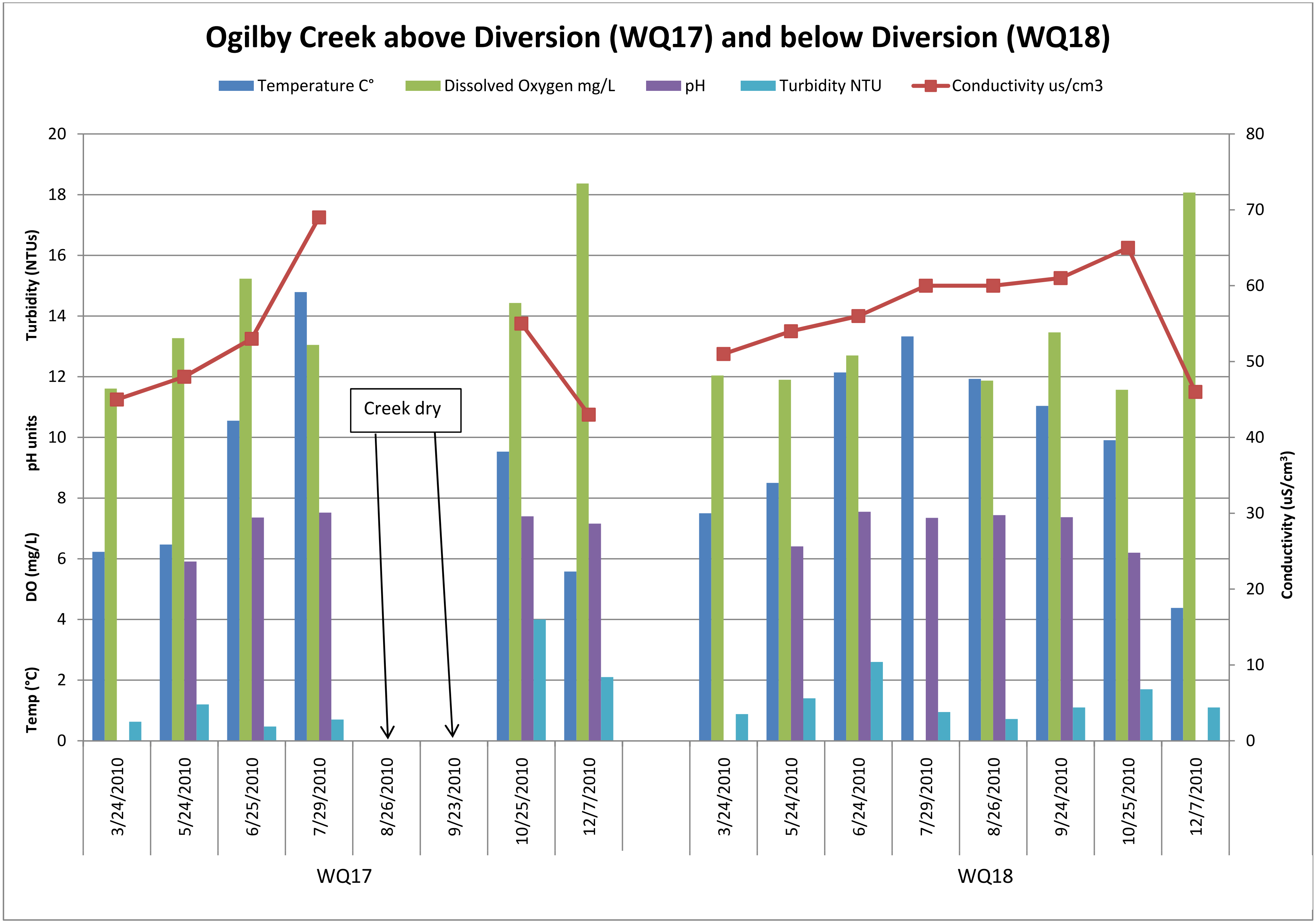

Figure 9. Water temperature, DO, pH, turbidity, and conductivity measured at Ogilby Creek above (WQ17) and below (WQ18) diversion in 2010

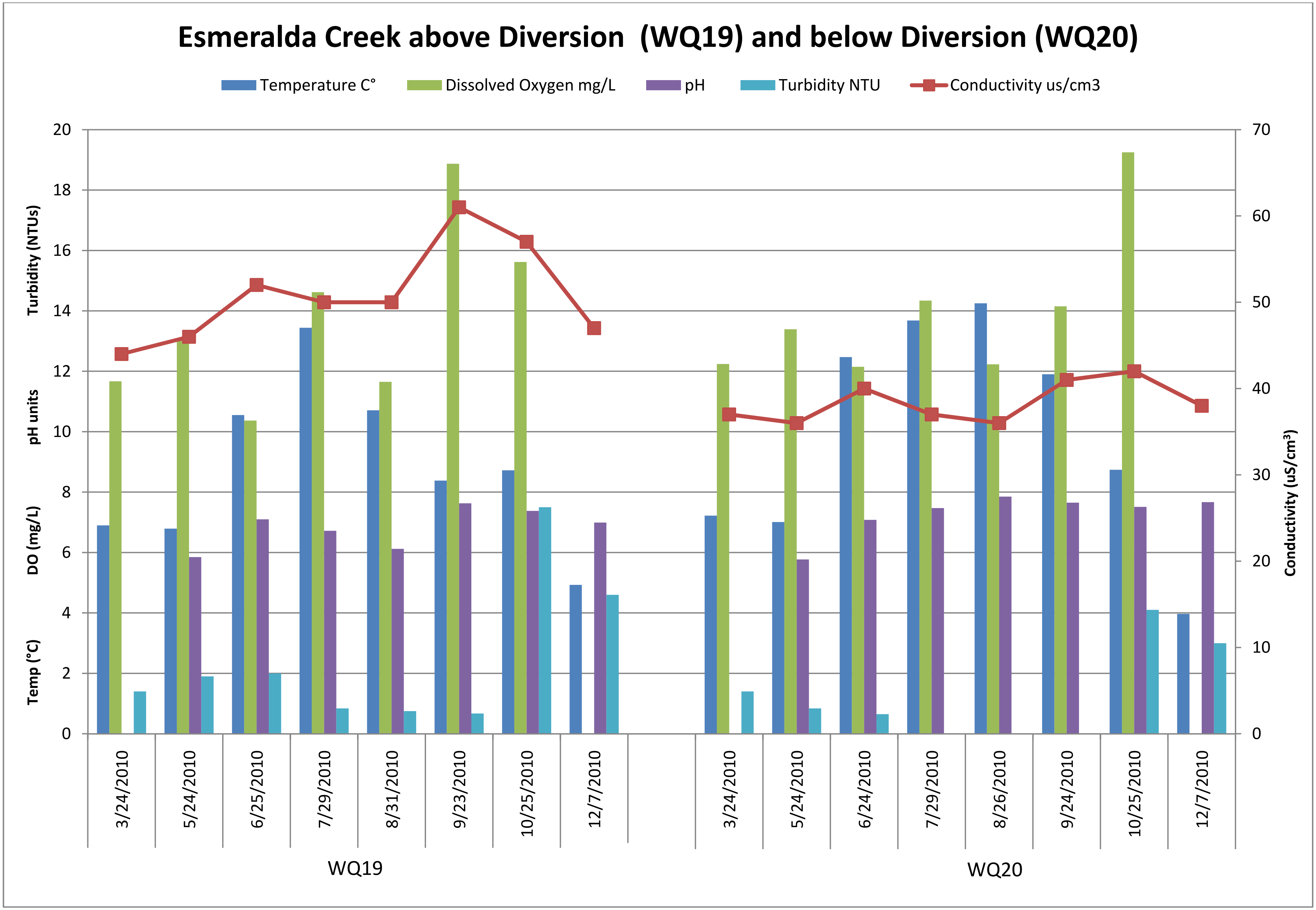

Figure 10. Water temperature, DO, pH, turbidity, and conductivity measured at Esmeralda Creek above (WQ19) and below (WQ20) diversion in 2010

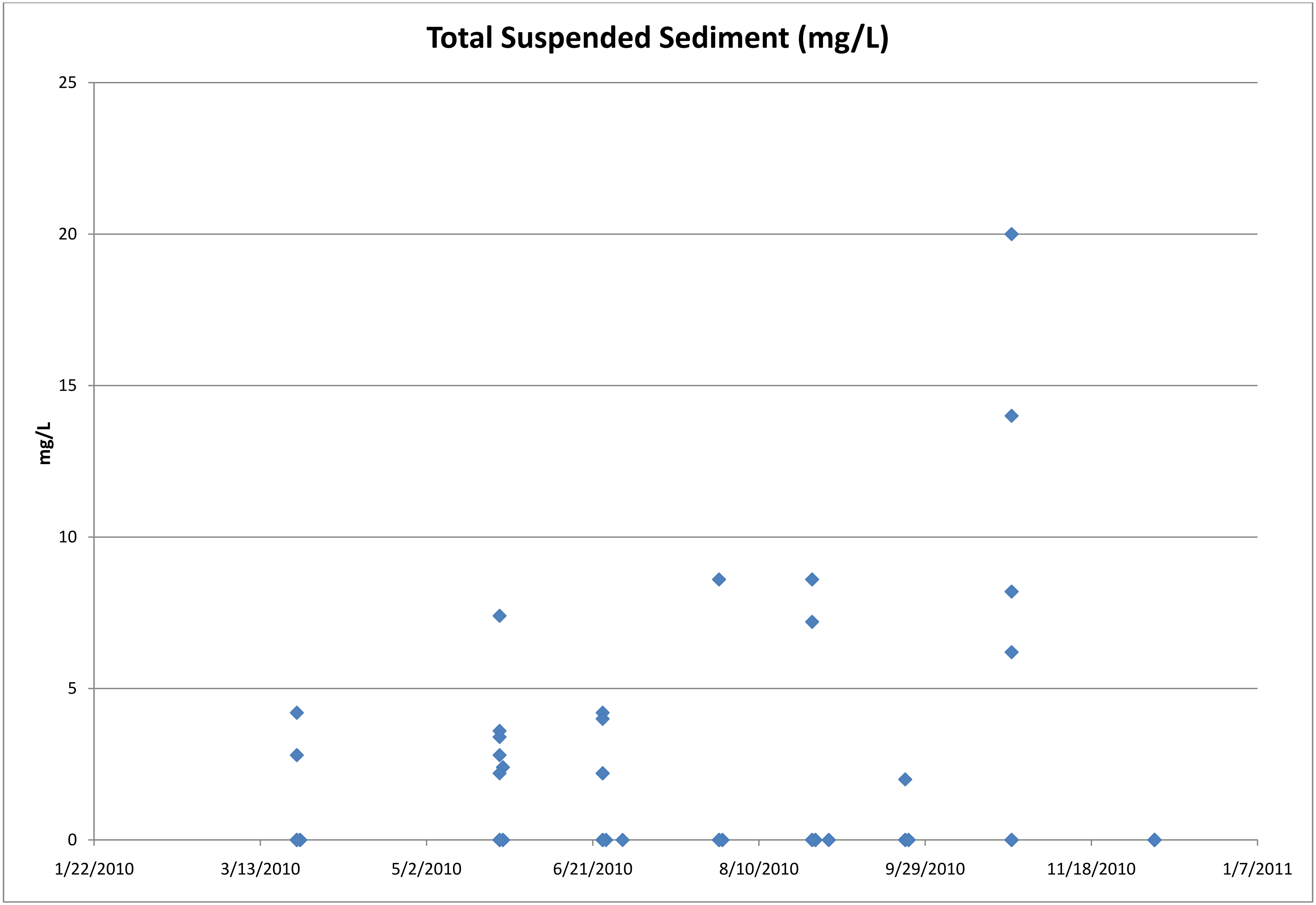

Figure 11. Total Suspended Sediment concentrations (mg/L) measured at all sample sites in 2010

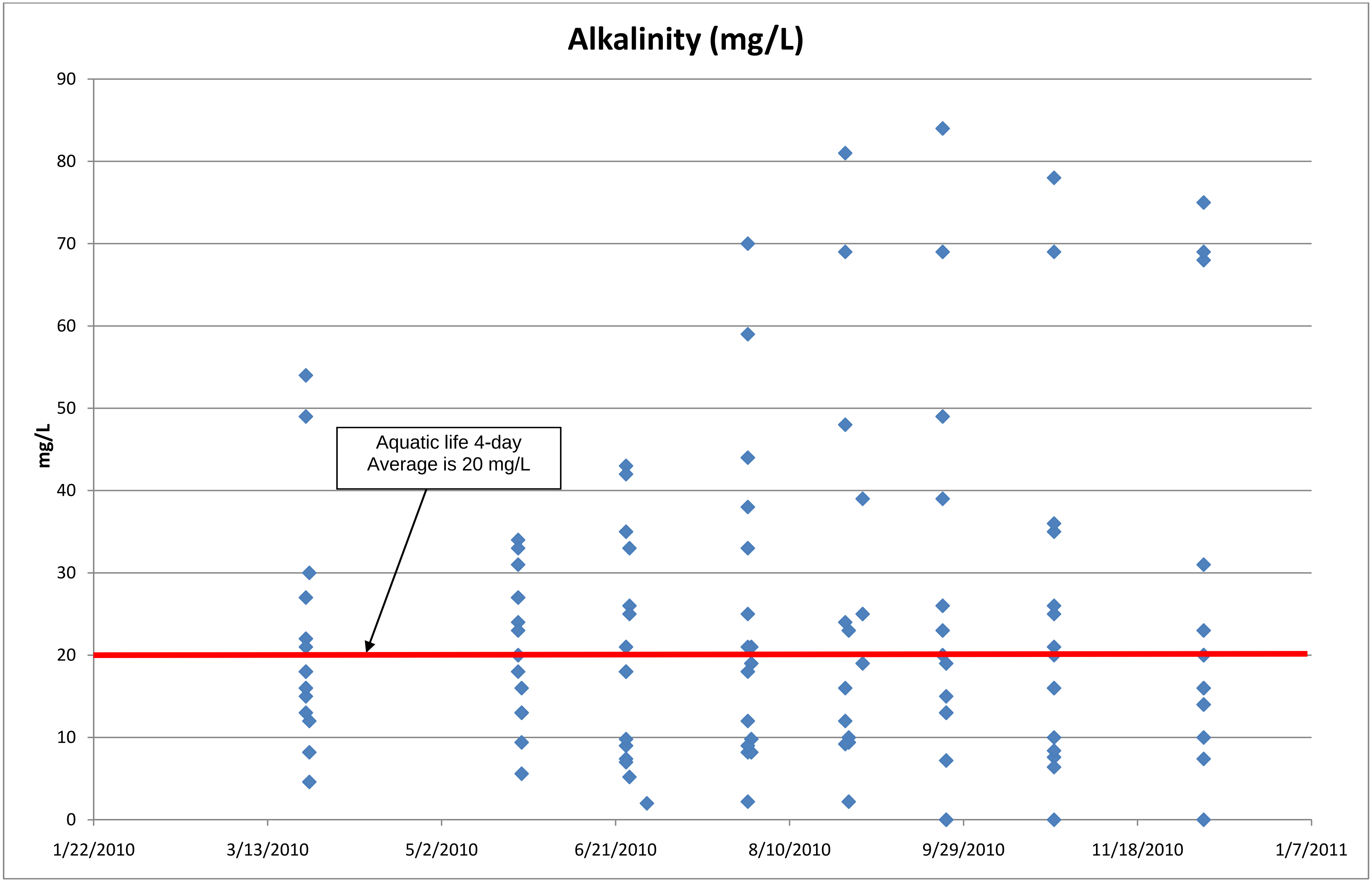

Figure 12. Alkalinity concentrations (mg/L) measured at all sample sites in 2010

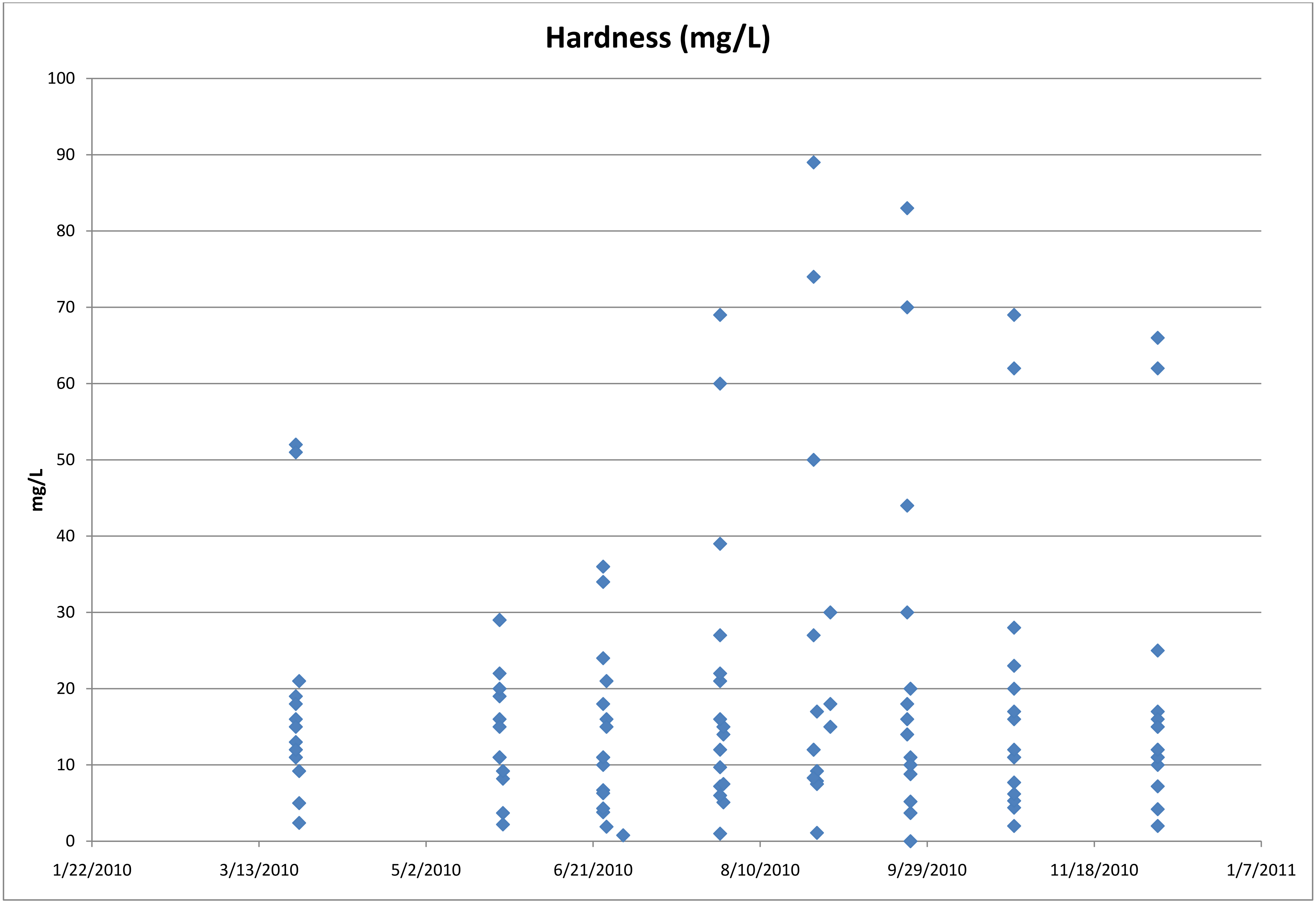

Figure 13. Hardness concentrations (mg/L) measured at all sample sites in 2010

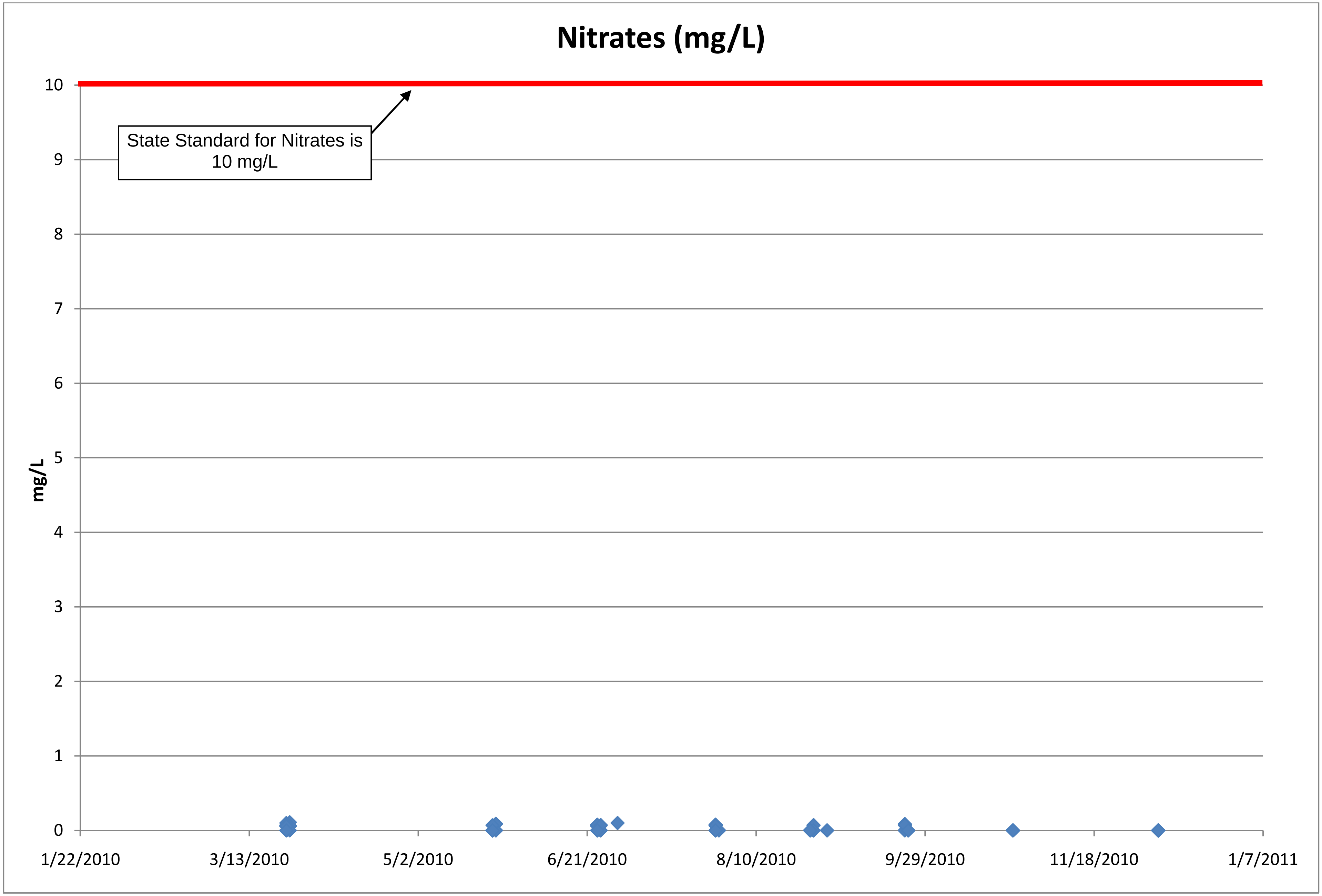

Figure 14. Nitrate concentrations (mg/L) measured at all sample sites in 2010

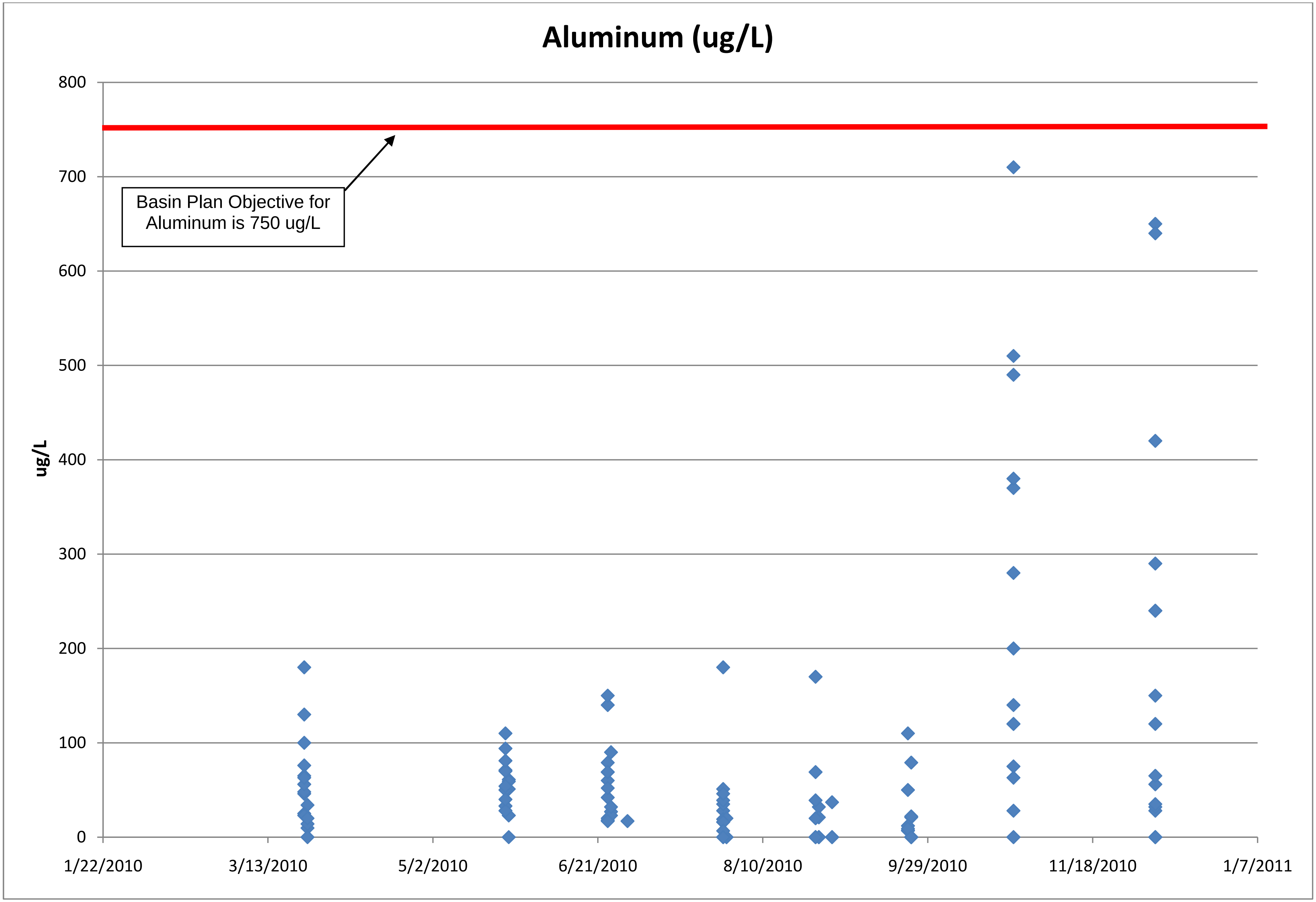

Figure 15. Aluminum concentrations (ug/L) measured at all sample sites in 2010

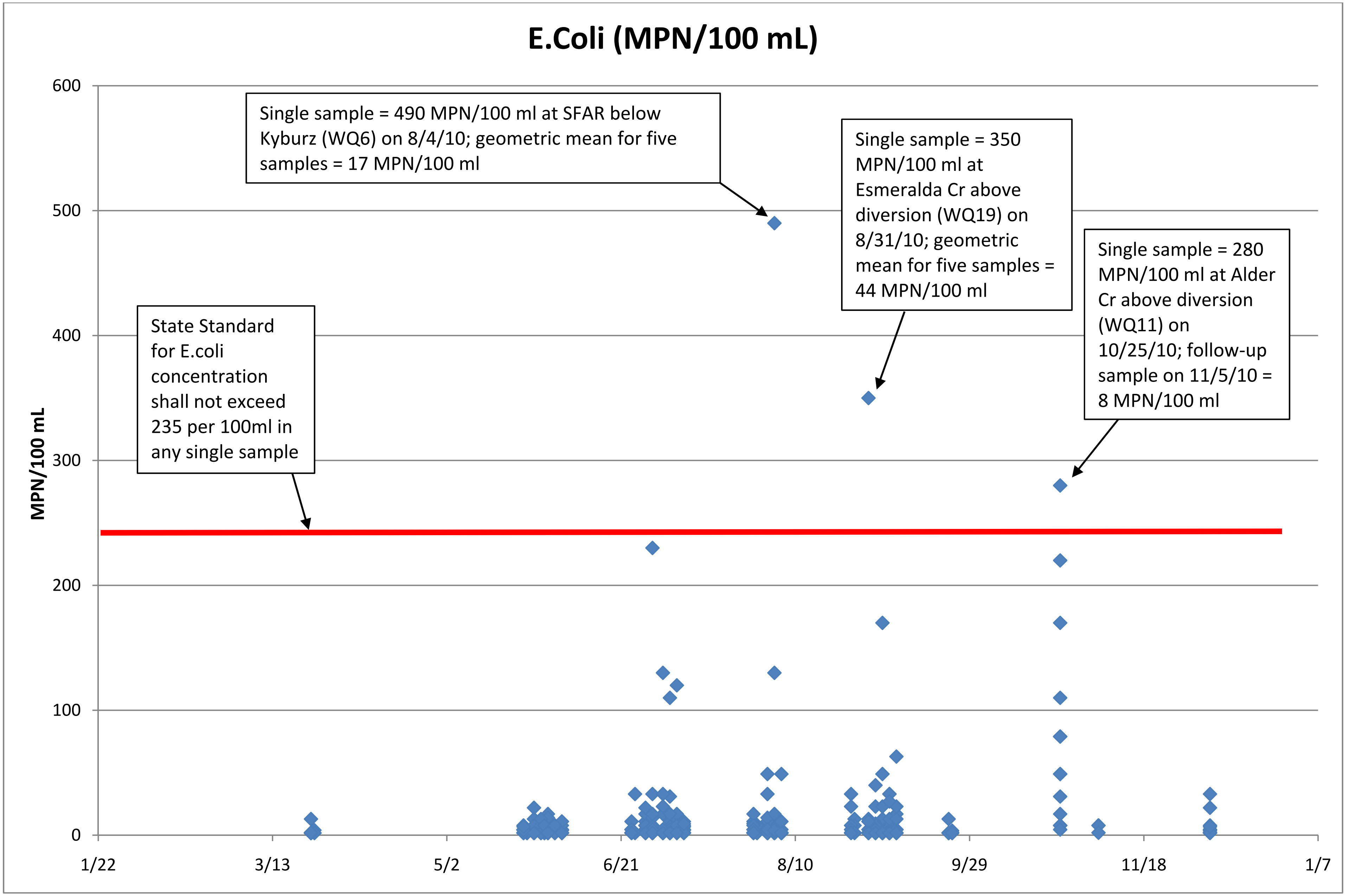

Figure 16. E.coli concentrations (MPN/100 mL) measured at all sample sites in 2010

Table 8. Water Quality Limits for Constituents and Parameters for Copper per California Toxics Rule Criteria to protect freshwater aquatic life. Results based on the following equation:

Criteria Maximum Concentration (1-hour Average, dissolved) = (e{0.9422[ln(hardness)] – 1.700})

Sample ID	Date	Copper ug/L	Hardness (mg/L)	Max dissolved Concentration (ug/L)
WQ-01	3/25/2010	ND	2.4	0.4001
WQ-01	5/25/2010	0.36	2.2	0.3686
WQ-01	6/25/2010	ND	1.9	0.3211
WQ-01	7/29/2010	0.66	7.2	1.1265
WQ-01	8/27/2010	0.27	7.9	1.2295
WQ-01	9/24/2010	ND	3.7	0.6016
WQ-01	10/25/2010	ND	2.0	0.3370
WQ-01	12/7/2010	ND	2.0	0.3370
WQ-02	6/30/2010	ND	0.8	0.1388
WQ-02	7/29/2010	0.95	1.0	0.1754
WQ-02	8/27/2010	ND	1.1	0.1919
WQ-02	9/24/2010	ND	1	0.1754
WQ-03	3/25/2010	0.36	9.2	1.4192
WQ-03	5/25/2010	0.38	9.2	1.4192
WQ-03	6/24/2010	ND	6.7	1.0527
WQ-03	7/30/2010	ND	7.5	1.1707
WQ-03	8/27/2010	ND	9.2	1.4192
WQ-03	9/24/2010	ND	8.8	1.3610
WQ-03	10/25/2010	ND	7.7	1.2001
WQ-03	12/7/2010	ND	7.2	1.1265
WQ-04	3/25/2010	ND	5.0	0.7990
WQ-04	5/25/2010	ND	3.7	0.6016
WQ-04	6/24/2010	ND	3.8	0.6169
WQ-04	7/30/2010	ND	5.1	0.8140
WQ-04	8/27/2010	ND	7.5	1.1707
WQ-04	9/24/2010	ND	5.2	0.8291
WQ-04	10/25/2010	ND	4.4	0.7083
WQ-04	12/7/2010	ND	4.2	0.6779
WQ-05	3/24/2010	0.27	11.0	1.6795
WQ-05	5/25/2010	0.44	8.2	1.2734
WQ-05	6/24/2010	ND	4.3	0.6931
WQ-05	7/29/2010	ND	6.0	0.9487
WQ-05	8/26/2010	ND	8.3	1.2880
WQ-05	9/24/2010	ND	10.0	1.5352
WQ-05	10/25/2010	ND	5.3	0.8441
WQ-05	12/7/2010	ND	11.0	1.6795
WQ-06	3/24/2010	ND	11.0	1.6795
WQ-06	5/25/2010	0.29	9.2	1.4192
WQ-06	6/24/2010	ND	6.3	0.9934
WQ-06	7/29/2010	ND	9.7	1.4918
WQ-06	8/26/2010	ND	12.0	1.8230
WQ-06	9/24/2010	ND	11.0	1.6795
WQ-06	10/25/2010	ND	6.2	0.9785
WQ-06	12/7/2010	ND	10.0	1.5352

Highlighted gray lines signify exceedence of copper criteria

WQ-09	3/24/2010	ND	52.0	7.2575
WQ-09	5/24/2010	0.37	29.0	4.1864
WQ-09	6/24/2010	ND	36.0	5.1324
WQ-09	7/29/2010	0.27	69.0	9.4740
WQ-09	8/26/2010	ND	89.0	12.0416
WQ-09	9/23/2010	ND	83.0	11.2752
WQ-09	10/25/2010	ND	69.0	9.4740
WQ-09	12/7/2010	ND	66.0	9.0854
WQ-10	3/24/2010	0.44	51.0	7.1260
WQ-10	5/24/2010	0.86	29.0	4.1864
WQ-10	6/24/2010	0.32	34.0	4.8633
WQ-10	7/29/2010	0.45	60.0	8.3051
WQ-10	8/26/2010	ND	74.0	10.1195
WQ-10	9/23/2010	0.34	70.0	9.6033
WQ-10	10/25/2010	ND	62.0	8.5657
WQ-10	12/7/2010	ND	62.0	8.5657
WQ-11	3/24/2010	0.49	12.0	1.8230
WQ-11	5/24/2010	1.20	11.0	1.6795
WQ-11	6/24/2010	ND	10.0	1.5352
WQ-11	7/30/2010	ND	14.0	2.1079
WQ-11	8/31/2010	ND	15.0	2.2495
WQ-11	9/23/2010	ND	14.0	2.1079
WQ-11	10/25/2010	ND	11.0	1.6795
WQ-11	12/7/2010	ND	11.0	1.6795
WQ-12	3/24/2010	ND	13.0	1.9657
WQ-12	5/24/2010	0.42	11.0	1.6795
WQ-12	6/24/2010	ND	11.0	1.6795
WQ-12	7/30/2010	ND	15.0	2.2495
WQ-12	8/27/2010	ND	17.0	2.5310
WQ-12	9/23/2010	0.26	16.0	2.3905
WQ-12	10/25/2010	ND	11.0	1.6795
WQ-12	12/7/2010	ND	12.0	1.8230
WQ-15	3/24/2010	0.29	19.0	2.8107
WQ-15	5/24/2010	0.59	19.0	2.8107
WQ-15	6/25/2010	ND	21.0	3.0886
WQ-15	7/29/2010	ND	27.0	3.9138
WQ-15	8/31/2010	ND	30.0	4.3223
WQ-15	9/23/2010	0.42	30.0	4.3223
WQ-15	10/25/2010	ND	23.0	3.3650
WQ-15	12/7/2010	ND	17.0	2.5310
WQ-16	3/25/2010	12.00	21.0	3.0886
WQ-16	5/24/2010	0.93	22.0	3.2270
WQ-16	6/24/2010	0.32	24.0	3.5027
WQ-16	7/29/2010	0.40	39.0	5.5344
WQ-16	8/26/2010	ND	50.0	6.9942
WQ-16	9/23/2010	0.86	44.0	6.2006
WQ-16	10/25/2010	ND	28.0	4.0503
WQ-16	12/7/2010	ND	25.0	3.6401

WQ-17	3/24/2010	0.27	16.0	2.3905
WQ-17	5/24/2010	0.32	16.0	2.3905
WQ-17	6/25/2010	ND	16.0	2.3905
WQ-17	7/29/2010	ND	21.0	3.0886
WQ-17	10/25/2010	ND	16.0	2.3905
WQ-17	12/7/2010	ND	15.0	2.2495
WQ-18	3/24/2010	0.42	18.0	2.6711
WQ-18	5/24/2010	0.75	20.0	2.9499
WQ-18	6/24/2010	0.65	18.0	2.6711
WQ-18	7/29/2010	ND	22.0	3.2270
WQ-18	8/26/2010	ND	27.0	3.9138
WQ-18	9/24/2010	ND	20.0	2.9499
WQ-18	10/25/2010	ND	20.0	2.9499
WQ-18	12/7/2010	ND	16.0	2.3905
WQ-19	3/24/2010	ND	15.0	2.2495
WQ-19	5/24/2010	1.20	15.0	2.2495
WQ-19	6/25/2010	ND	15.0	2.2495
WQ-19	7/29/2010	ND	16.0	2.3905
WQ-19	8/31/2010	ND	18.0	2.6711
WQ-19	9/23/2010	ND	18.0	2.6711
WQ-19	10/25/2010	ND	17.0	2.5310
WQ-19	12/7/2010	ND	15.0	2.2495
WQ-20	3/24/2010	ND	12.0	1.8230
WQ-20	5/24/2010	0.56	11.0	1.6795
WQ-20	6/24/2010	ND	11.0	1.6795
WQ-20	7/29/2010	ND	12.0	1.8230
WQ-20	8/26/2010	ND	12.0	1.8230
WQ-20	9/24/2010	ND	10.0	1.5352
WQ-20	10/25/2010	ND	12.0	1.8230
WQ-20	12/7/2010	ND	12.0	1.8230