

March 2014

Norwest Corporation (Norwest) maintains three gaging stations for Pioneer Natural Resources USA Inc. (PNR) in the headwaters of the Apishapa River in northern Las Animas County, Colorado. The Apishapa River is a tributary of the Arkansas River. The gaging stations acquire “continuous” data on 15-minute intervals for pressure, temperature, conductivity, calculated SAR, and calculated flow using an In-Situ Aqua Troll. Communication of the near real-time continuous data is accomplished using Iridium satellite telemetry and is available online at www.apishapawatershed.org. Norwest visits the stations every two weeks to download the data, calibrate the equipment, acquire instantaneous flow measurements, collect field parameters of pH, temperature, conductivity and salinity, and collect water quality samples. All monitoring conducted at each station is voluntary and is not required by any regulatory agency.

The three stations on the Apishapa are shown on **Figure 1**. The Belarde station is furthest upstream and has a contributing watershed of 59.3 square miles. The Eichler station is located downstream, and has a contributing watershed of 72.9 square miles. The Lisonbee station is located further downstream, southwest of Aguilar, slightly upstream of the historic USGS gage 07118000, and has a contributing watershed of 141.7 square miles. The Eichler and Lisonbee stations are located downstream of the Apishapa’s confluence with tributaries potentially influenced by coalbed methane discharge waters.

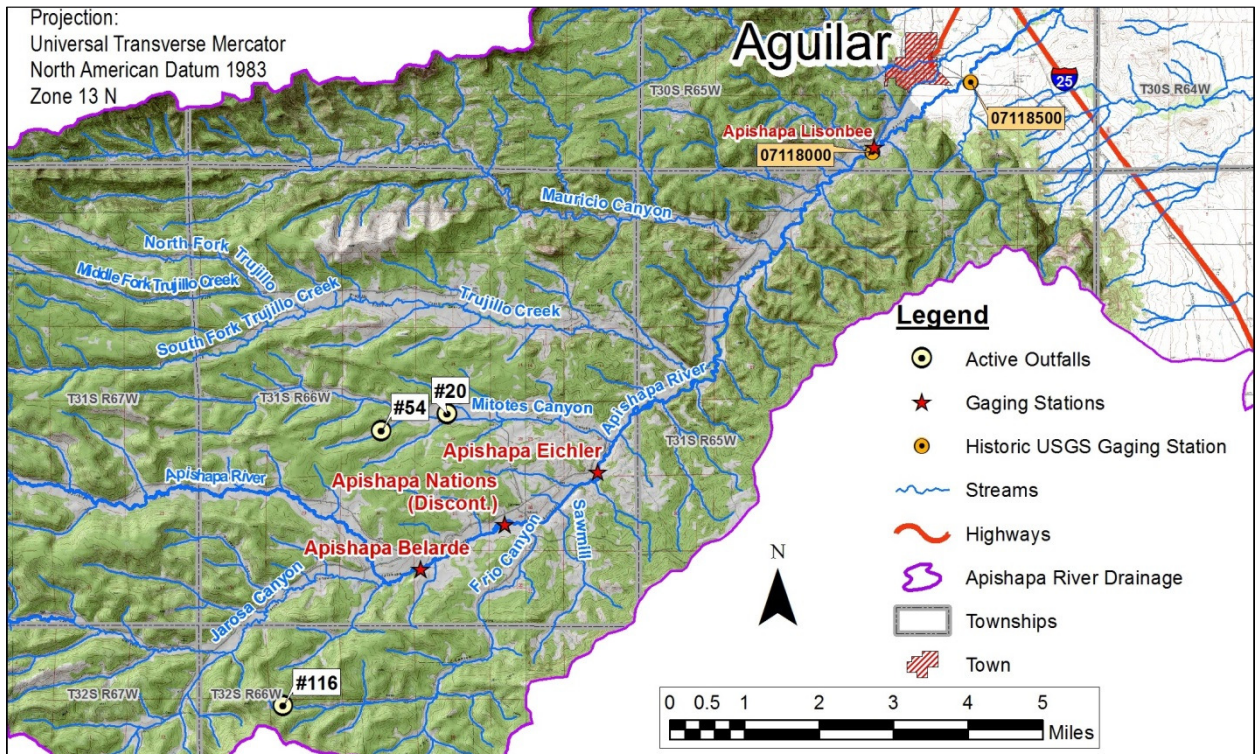


FIGURE 1
APISHAPA WATERSHED

The U.S. Drought Monitor prepares maps weekly for drought conditions throughout the contiguous United States. The U.S. Drought Monitor is produced in partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln (NDMC-UNL), the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration. **Figure 2** depicts drought conditions in Colorado for data received as of 7 a.m. EST on March 4, 2014. **Figure 3** depicts drought conditions in Colorado for data received as of 7 a.m. EST on April 1, 2014. The drought intensity for the western portion of Las Animas County increased from a combination of D0 and D1 drought conditions to mostly D1 drought conditions with a sliver of D0 conditions on the western border of the county. The drought intensity for the central portion of Las Animas County remained the same throughout the month of March with D1 and D2 drought conditions, with a small area of D3 conditions in the south part of the county. D2 drought conditions remained throughout March in the eastern part of the county, with D3 drought conditions increasing in the northeast and southeast parts of the county by the end of March (Drought Monitor, 2014).

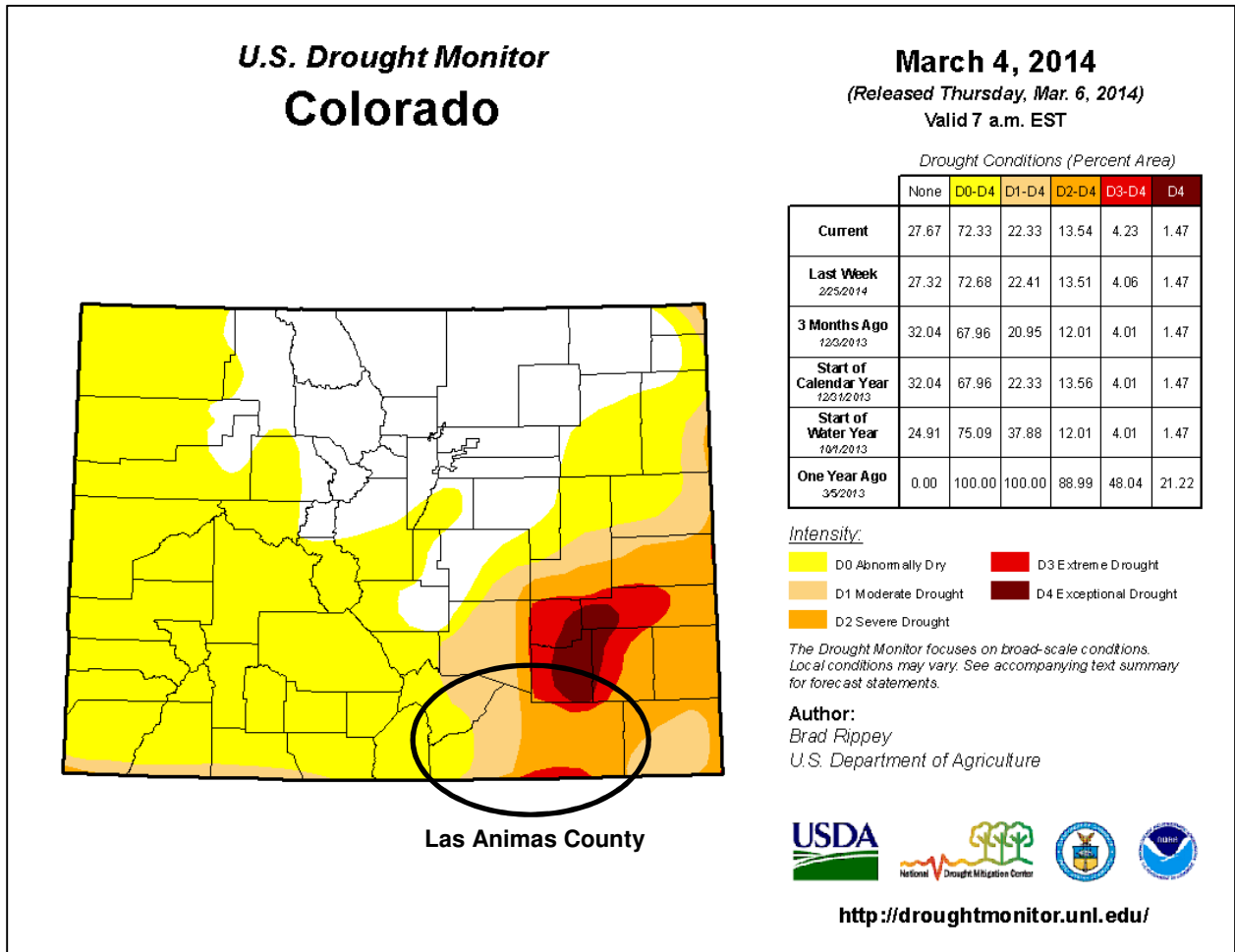


FIGURE 2
U.S. DROUGHT MONITOR COLORADO – MARCH 4, 2014

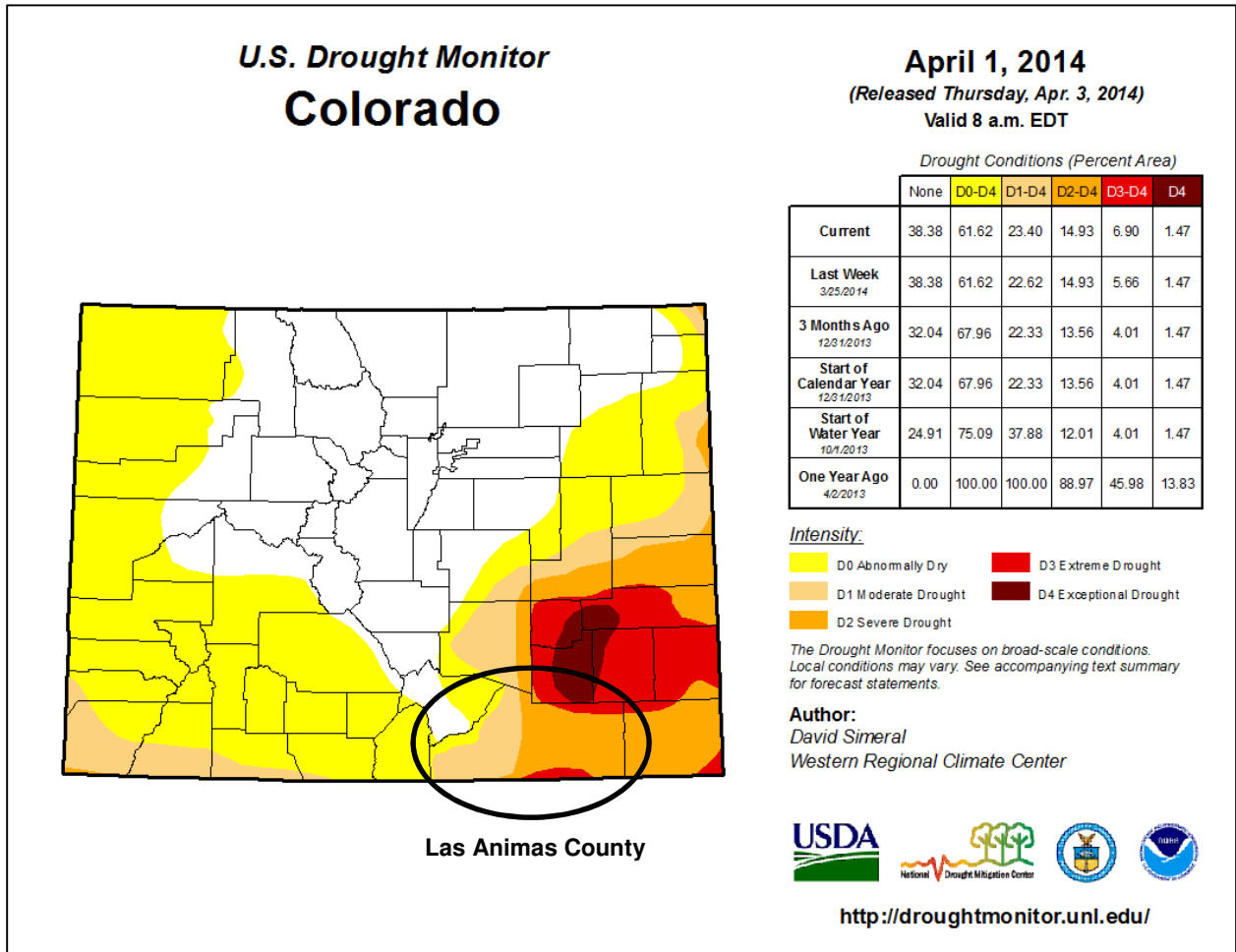


FIGURE 3
U.S. DROUGHT MONITOR COLORADO – APRIL 1, 2014

The three gaging stations on the Apishapa River discussed in this report are located in the southwest part of the county with the D1 drought conditions mentioned above. Recordable flow was present at all three stations the entire month of March 2014. Laboratory water quality samples were collected and streamflow was measured at all three stations during the two March 2014 site visits.

March 2014 data exhibited a calculated daily average flow of 1.12 cfs at Belarde, 1.32 cfs at Eichler, and 1.61 cfs at Lisonbee. Temperatures were seasonal. The daily average specific conductance at Belarde ranged from 243 $\mu\text{s}/\text{cm}$ to 318 $\mu\text{s}/\text{cm}$, with a median value of 260 $\mu\text{s}/\text{cm}$ (**Table 1**). The daily average specific conductance at Eichler ranged from 438 $\mu\text{s}/\text{cm}$ to 709 $\mu\text{s}/\text{cm}$, with a median value of 503 $\mu\text{s}/\text{cm}$ (**Table 1**). The daily average specific conductance at Lisonbee ranged from 521 $\mu\text{s}/\text{cm}$ to 651 $\mu\text{s}/\text{cm}$, with a median value of 613 $\mu\text{s}/\text{cm}$ (**Table 1**). The calculated daily average sodium adsorption ratio (SAR) values in March 2014 ranged from 0.52 to 0.63 at Belarde, 0.96 to 1.54 at Eichler, and 1.61 to 2.00 at Lisonbee (**Table 1**).

TABLE 1
MARCH 2014 DAILY AVERAGE GAGE DATA

	Average Daily			
	Minimum	Median	Average	Maximum
Belarde - (31 days of flow data)				
Water Level (ft)	0.45	0.52	0.51	0.58
Flow ¹ (cfs)	0.56	1.13	1.12	1.95
Temperature (°C)	2.19	5.58	5.36	8.17
Conductivity (µs/cm)	243	260	270	318
TDS ² (mg/l)	158	169	175	206
Sodium Adsorption Ratio ³ (SAR)	0.52	0.54	0.55	0.63
Eichler - (31 days of flow data)				
Water Level (ft)	0.55	0.66	0.65	0.71
Flow ¹ (cfs)	0.58	1.38	1.32	1.85
Temperature (°C)	1.12	5.11	5.30	8.50
Conductivity (µs/cm)	438	503	550	709
TDS ² (mg/l)	285	327	358	461
Sodium Adsorption Ratio ³ (SAR)	0.96	1.10	1.20	1.54
Lisonbee - (31 days of flow data)				
Water Level (ft)	0.30	0.34	0.34	0.37
Flow ¹ (cfs)	0.72	1.62	1.61	2.64
Temperature (°C)	3.70	6.25	6.41	8.78
Conductivity (µs/cm)	521	613	604	651
TDS ² (mg/l)	339	399	393	423
Sodium Adsorption Ratio ³ (SAR)	1.61	1.88	1.86	2.00
¹ Calculated from pressure data				
² Calculated from conductivity data with a conversion of 0.65 mg/l TDS per µs/cm specific conductance				
³ Derived from a historic multivariate regression analysis of conductivity and flow				

The mainstem of the Apishapa River has been classified by the Colorado Water Quality Control Commission (WQCC) as supporting aquatic life, recreation, water supply, and agriculture (CDPHE WQCC, 2013 (1)). During the month of March 2014, the water type at the Belarde and Eichler stations was a calcium bicarbonate water, with a calcium-sodium bicarbonate water type at the Lisonbee station.

March 2014 field measured SC values and laboratory measured SAR values at the Belarde, Eichler, and Lisonbee stations are illustrated in **Figure 4**. All three stations were below the SC threshold limit of 1300 µs/cm and the SAR threshold limit of 6.8 (**Figure 4**). These SC and SAR threshold limits have been identified by the Colorado Department of Public Health and Environment (CDPHE) for protection of downstream alfalfa crops (CDPHE, 2010).

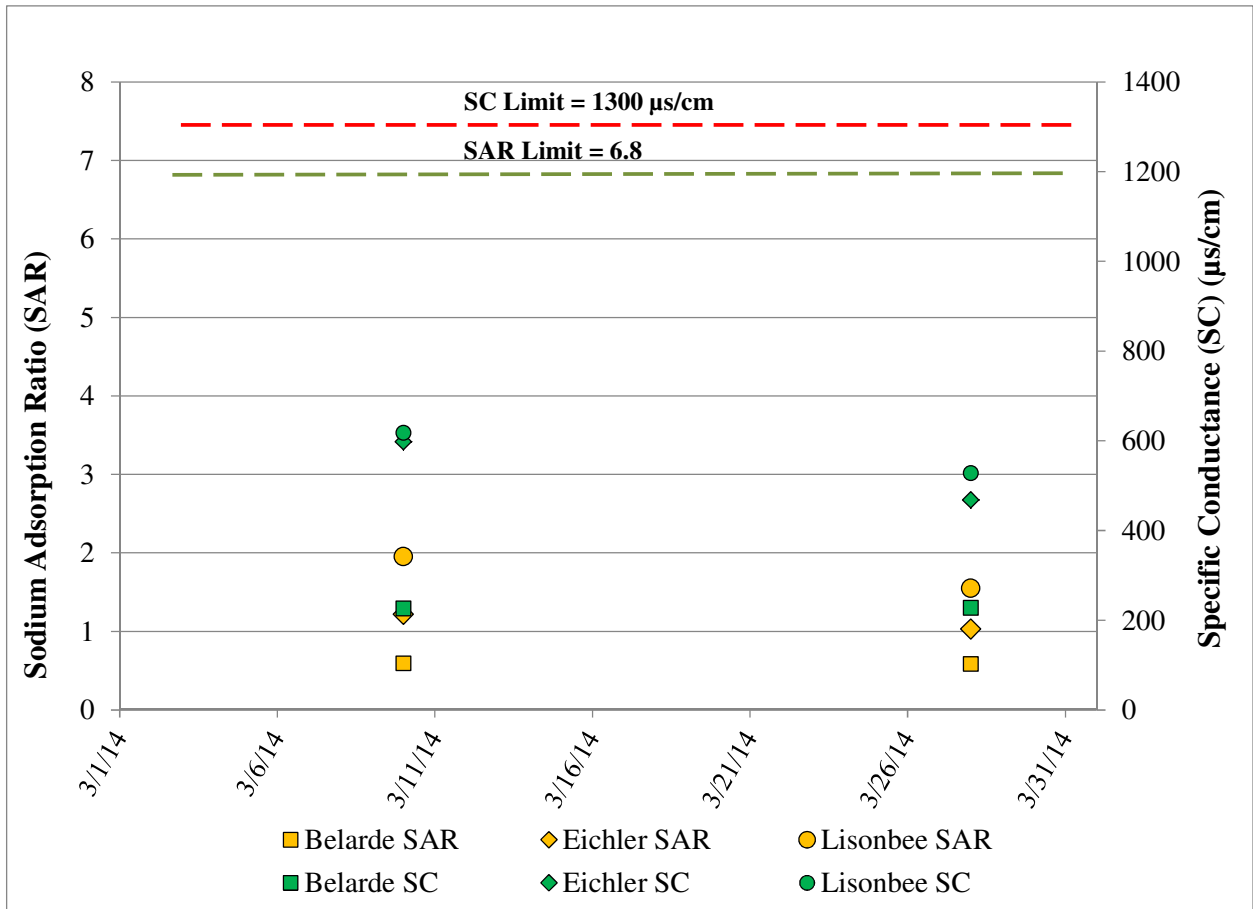


FIGURE 4
MARCH 2014 SPECIFIC CONDUCTANCE AND SAR

The water in March exhibits a range of hardness, with Belarde ranging from 102 mg/l CaCO₃ to 121 mg/l CaCO₃ hardness, Eichler ranging from 184 mg/l CaCO₃ to 254 mg/l CaCO₃ hardness, and Lisonbee ranging from 190 mg/l CaCO₃ to 233 mg/l CaCO₃ hardness (**Table 2**). Based on toxicity testing, aquatic species protection from elevated heavy metal concentrations increases as hardness increases (CDPHE WQCC, 2013 (2)). Lower hardness values, closer to 25 mg/l CaCO₃, have lower hardness based metal standards to provide aquatic life protection and higher hardness values, closer to 400 mg/l CaCO₃, can afford higher hardness based metal standards to provide aquatic life protection (CDPHE WQCC, 2013 (2)).

Stream water quality is affected by the quantity of sediment in the stream. Sediment concentrations increase during storm events or snowmelt runoff. Analyses of the total recoverable forms of metals typically increase with increased sediment concentrations, as the laboratory analytical digestions dissolve the sediment. Total suspended solids (TSS) in March 2014 ranged from 6.8 mg/l to 8.8 mg/l at the Belarde station, was <4 mg/l for both samples at the Eichler station, and ranged from 7.6 mg/l to 31 mg/l at the Lisonbee station (**Figure 5**). TSS values less than the detection limit of 4 mg/l are plotted as ½ the

detection limit in **Figure 5**. Total recoverable iron concentrations ranged from 0.591 mg/l to 0.620 mg/l at Belarde, 0.300 mg/l to 0.403 mg/l at Eichler, and 0.140 mg/l to 0.339 mg/l at Lisonbee (**Figure 5**).

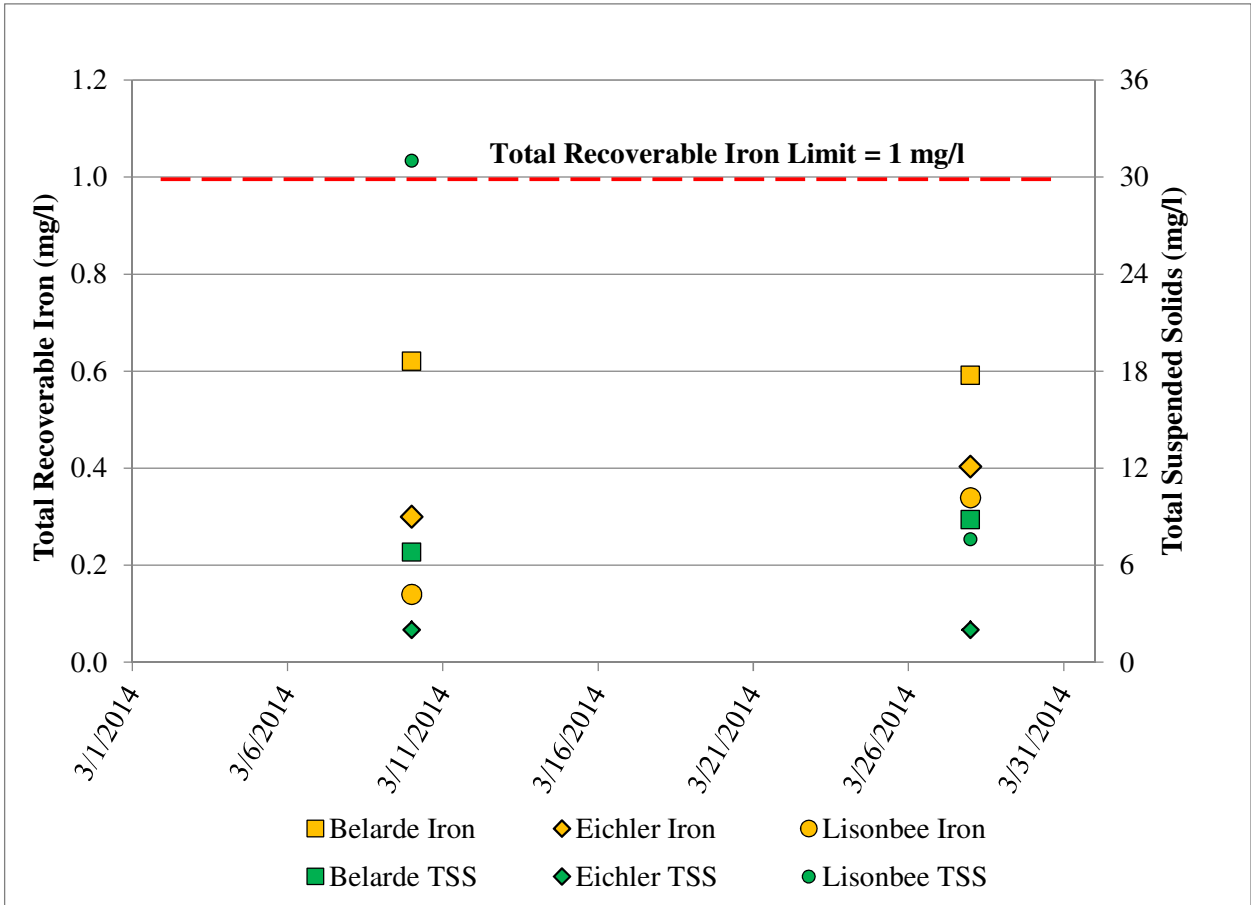


FIGURE 5
MARCH 2014 INSTANTANEOUS TOTAL RECOVERABLE IRON (MG/L) AND TOTAL SUSPENDED SOLIDS (MG/L)

Constituents below the detection limit at all three stations in March 2014 include arsenic, boron, chromium, copper, and selenium. Measured concentrations of potentially dissolved copper were below the detection limit of 15 µg/l at all three stations (**Table 2**). However, the hardness adjusted stream standard for acute and chronic potentially dissolved copper at Belarde was lower than the 15 µg/l detection limit during both sampling events except for the March 10, 2014 acute copper standard (**Table 2**). Measured concentrations of potentially dissolved manganese and potential dissolved zinc were lower than the hardness adjusted stream standards established by the WQCC (**Table 2**). Chloride and sulfate were below the stream standards at the Belarde, Eichler, and Lisonbee stations (**Table 3**). The field pH values in March 2014 were within the stream standard of between 6.5 and 9.0 at all three stations (**Table 3**).

TABLE 2

HARDNESS BASED STREAM STANDARDS ASSOCIATED WITH APISHAPA RIVER INSTANTANEOUS SAMPLING, MARCH 2014 (CDPHE WQCC, 2013 (2))

Site	Sample Date	Stream Segment	Calculated Hardness ¹ (mg/l CaCO ₃)	Acute Copper (Pot. Diss.) (µg/l)	Chronic Copper (Pot Diss.) (µg/l)	Chronic Iron (T-Rec.) (mg/l)	Acute Manganese (Pot. Diss.) (µg/l)	Chronic Manganese (Pot. Diss.) (µg/l)	Acute Zinc (Pot. Diss.) (µg/l)	Chronic Zinc (Pot. Diss.) (µg/l)
Belarde Hardness Based Standards	3/10/2014	3a	121	16.1	10.5	1	3181	1758	190	144
Belarde Hardness Based Standards	3/28/2014	3a	102	13.7	9.1	1	3005	1661	163	123
Belarde Maximum March Results			NA	<15	<15	0.620	64	64	<20	<20
Eichler Hardness Based Standards	3/10/2014	3a	254	32.3	19.9	1	4073	2250	373	283
Eichler Hardness Based Standards	3/28/2014	3a	184	23.9	15.1	1	3658	2021	279	211
Eichler Maximum March Results			NA	<15	<15	0.403	210	210	<20	<20
Lisonbee Hardness Based Standards	3/10/2014	3a	233	29.8	18.5	1	3957	2186	345	262
Lisonbee Hardness Based Standards	3/28/2014	3a	190	24.6	15.5	1	3697	2043	287	217
Lisonbee Maximum March Results			NA	<15	<15	0.339	71	71	20	20

¹ A hardness value of 400 mg/l CaCO₃ is used to calculate the metal standards when the measured hardness values are greater than 400 mg/l CaCO₃

TABLE 3

STREAM STANDARDS ASSOCIATED WITH APISHAPA RIVER INSTANTANEOUS SAMPLING, MARCH 2014 (CDPHE WQCC, 2013 (2))

Site	Sample Date	Stream Segment	Arsenic (Total) (µg/l)	Boron (Total) (mg/l)	Acute Chromium (Total) (µg/l)	Chronic Chromium (Total) (µg/l)	Chloride (mg/l)	Acute Selenium (T-Rec.) (µg/l)	Chronic Selenium (T-Rec.) (µg/l)	Sulfate (mg/l)	pH-low (s.u.)	pH-High (s.u.)
Belarde Standards	3/10/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Belarde Standards	3/28/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Belarde Maximum March Results¹			<15	<0.05	<10	<10	4.7	<4	<4	37	8.13	8.29
Eichler Standards	3/10/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Eichler Standards	3/28/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Eichler Maximum March Results¹			<15	<0.05	<10	<10	33	<4	<4	59	8.15	8.20
Lisonbee Standards	3/10/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Lisonbee Standards	3/28/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Lisonbee Maximum March Results¹			<15	<0.05	<10	<10	14	<4	<4	75	8.16	8.55
¹ Minimum result identified for pH-low												

References

Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Commission (WQCC), 2013 (1). 5 CCR 1002-32, Regulation No. 32 Classifications and Numeric Standards for Arkansas River Basin, Amended August 12, 2013, Effective December 31, 2013.

Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Commission (WQCC), 2013 (2). 5 CCR 1002-31, Regulation No. 31 The Basic Standards and Methodologies for Surface Water, Amended September 11, 2012, Effective January 31, 2013.

Colorado Department of Public Health and Environment (CDPHE), 2010. Apishapa CBM Facility, Water Quality Assessment, Draft Discharge Permit CO0048313, Pioneer Natural Resources, USA, Inc.

U.S. Drought Monitor, 2014. Weekly maps and reports available from the Internet at <http://droughtmonitor.unl.edu/MapsAndData/MapArchive.aspx>.