

April 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.

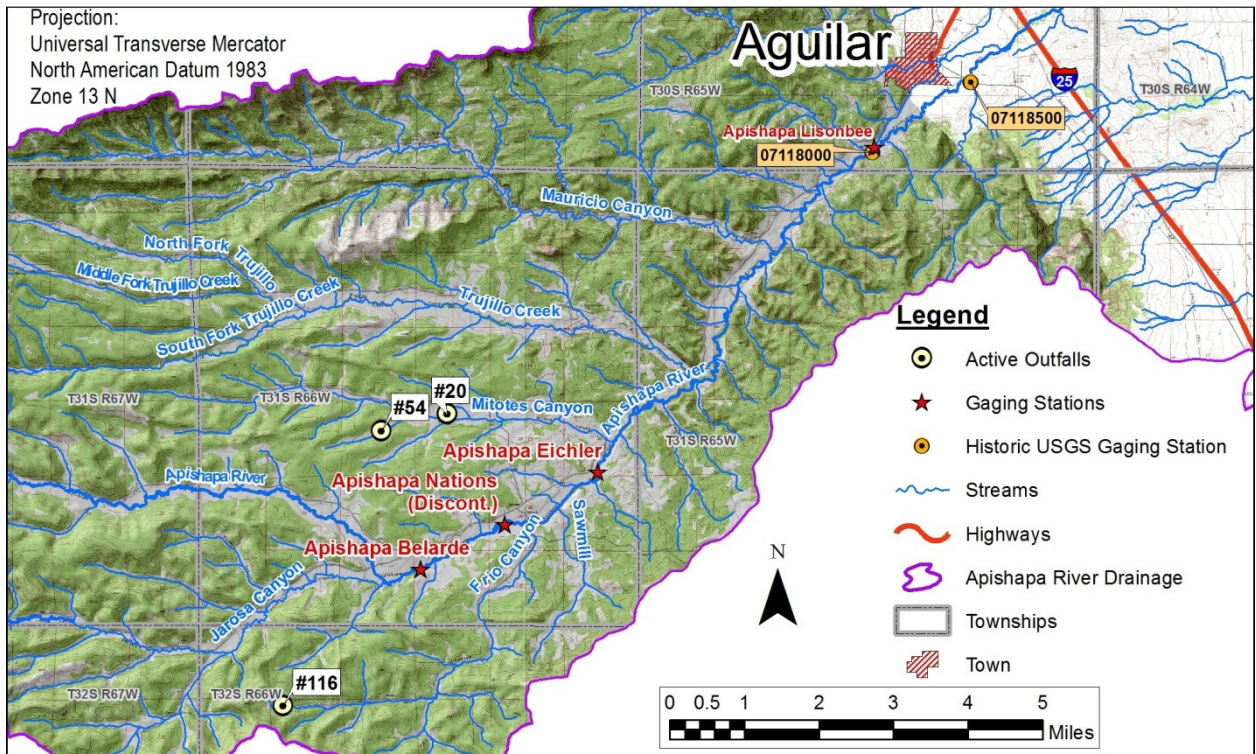


FIGURE 1
APISHAPA WATERSHED

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 April 1, 2014. **Figure 3** depicts drought conditions in Colorado for data received as of 7 a.m. EST on April 29, 2014. The D1 drought conditions remained the same throughout the month of April for the western portion of Las Animas County, with a sliver of D0 conditions on the western border of the county. The drought intensity for the central portion of Las Animas County also remained the same throughout the month of April 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 April in the eastern part of the county, with D3 drought conditions in the northeast and southeast parts of the county (Drought Monitor, 2014).

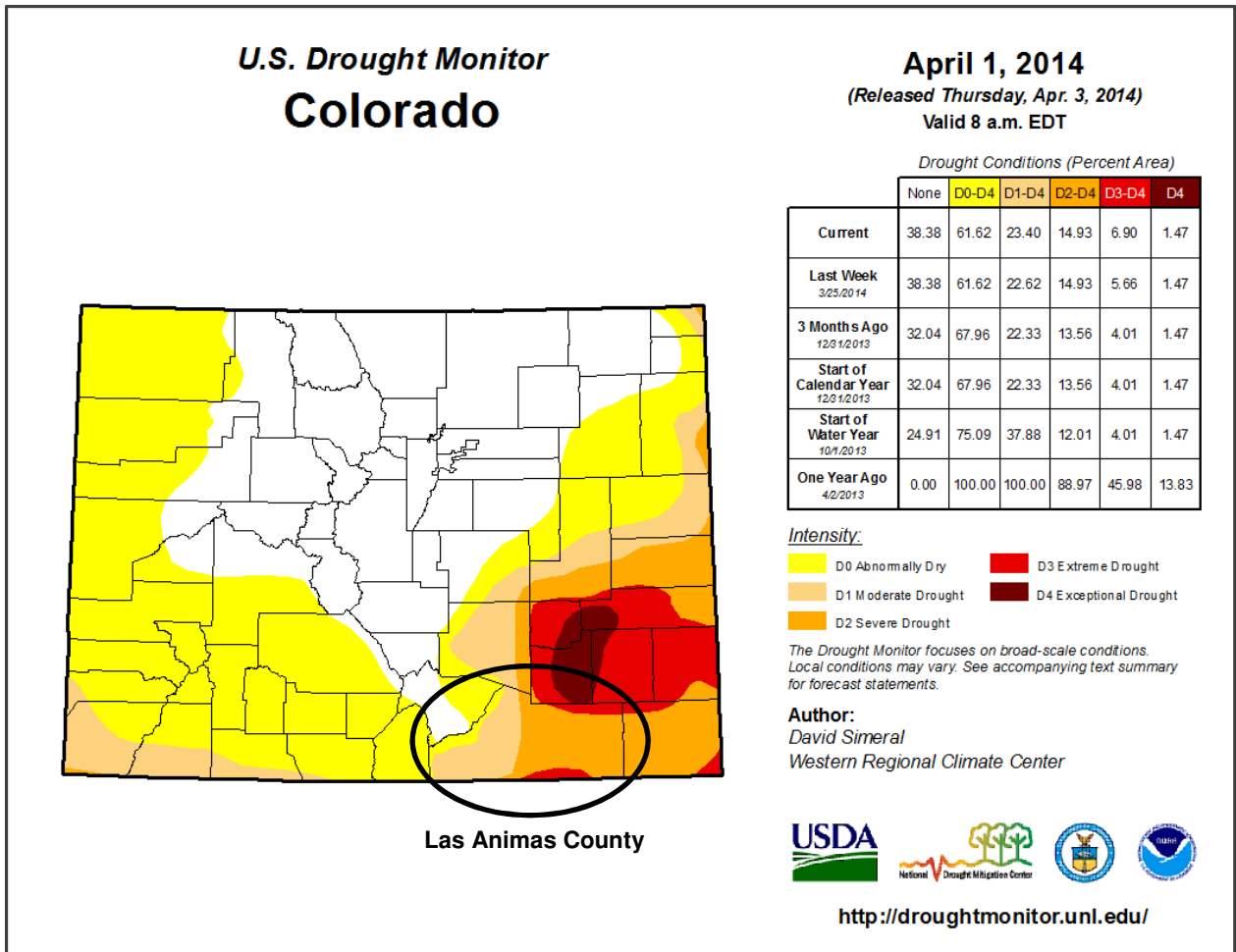


FIGURE 2
U.S. DROUGHT MONITOR COLORADO – APRIL 1, 2014

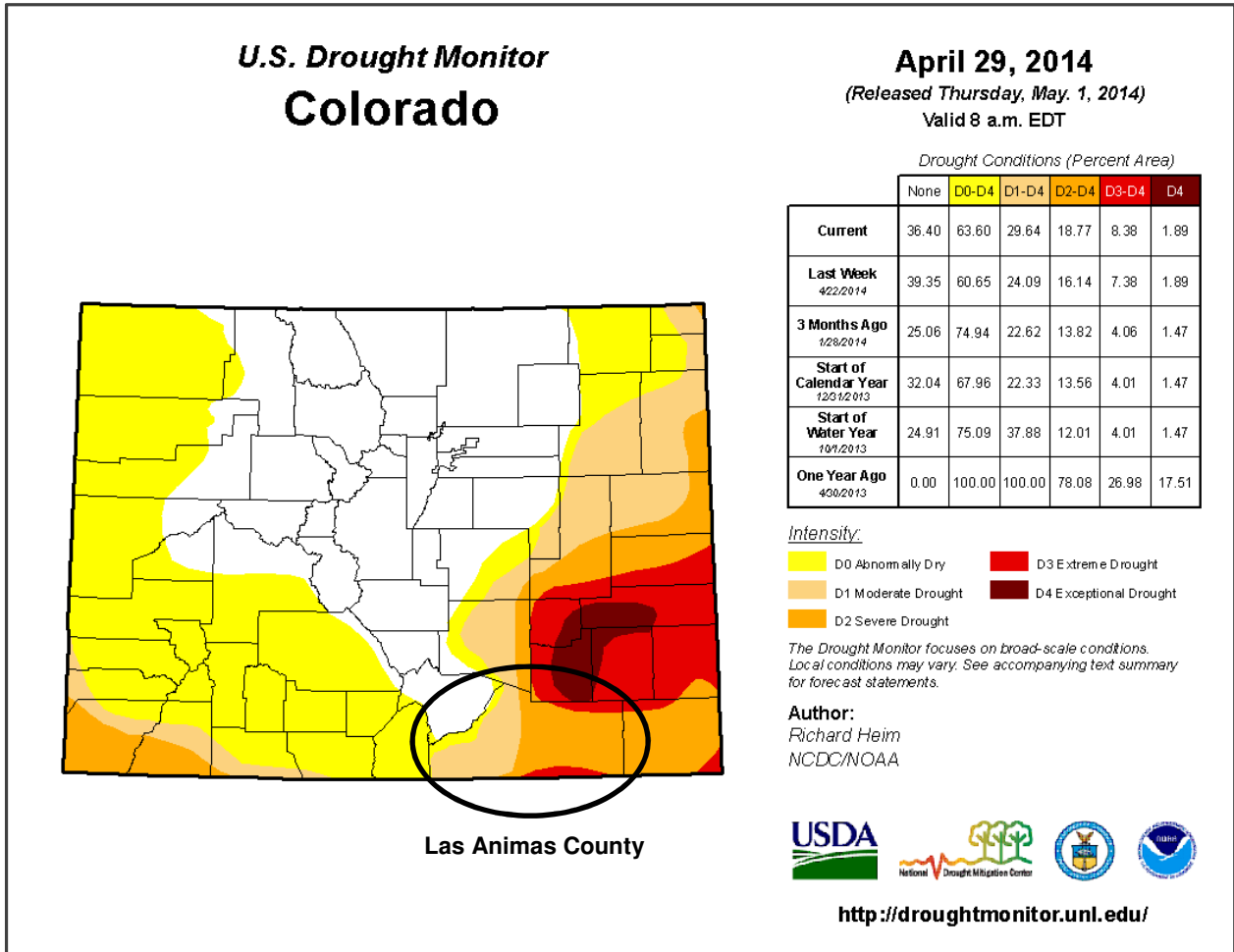


FIGURE 3
U.S. DROUGHT MONITOR COLORADO – APRIL 29, 2014

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 April 2014. Laboratory water quality samples and streamflow measurements were collected on April 15, 2014 at all three stations. Streamflow was also measured at each station on April 24, 2014 to capture peak spring runoff with an instantaneous flow measurement of 27.05 cfs at Belarde, 24.64 cfs at Eichler, and 28.16 cfs at Lisonbee.

April 2014 data exhibited a calculated daily average flow of 9.63 cfs at Belarde, 9.83 cfs at Eichler, and 18.78 cfs at Lisonbee. Temperatures were seasonal. The daily average specific conductance at Belarde ranged from 148 $\mu\text{s}/\text{cm}$ to 262 $\mu\text{s}/\text{cm}$, with a median value of 229 $\mu\text{s}/\text{cm}$ (**Table 1**). The daily average specific conductance at Eichler ranged from 298 $\mu\text{s}/\text{cm}$ to 473 $\mu\text{s}/\text{cm}$, with a median value of 438 $\mu\text{s}/\text{cm}$ (**Table 1**). The daily average specific conductance at Lisonbee ranged from 230 $\mu\text{s}/\text{cm}$ to 519 $\mu\text{s}/\text{cm}$, with a median value of 386 $\mu\text{s}/\text{cm}$ (**Table 1**). The calculated daily average sodium adsorption ratio (SAR) values in April 2014 ranged from 0.23 to 0.53 at Belarde, 0.44 to 1.03 at Eichler, and 0.69 to 1.60 at Lisonbee (**Table 1**).

TABLE 1
APRIL 2014 DAILY AVERAGE GAGE DATA

	Average Daily			
	Minimum	Median	Average	Maximum
Belarde - (30 days of flow data)				
Water Level (ft)	0.46	0.64	0.99	2.66
Flow ¹ (cfs)	0.68	2.98	9.63	43.79
Temperature (°C)	4.20	8.03	7.85	11.83
Conductivity (µs/cm)	148	229	215	262
TDS ² (mg/l)	96	149	140	171
Sodium Adsorption Ratio ³ (SAR)	0.23	0.46	0.42	0.53
Eichler - (30 days of flow data)				
Water Level (ft)	0.69	0.93	1.10	2.46
Flow ¹ (cfs)	1.74	4.66	9.83	51.64
Temperature (°C)	4.91	8.65	8.81	12.10
Conductivity (µs/cm)	298	438	405	473
TDS ² (mg/l)	194	284	263	308
Sodium Adsorption Ratio ³ (SAR)	0.44	0.80	0.79	1.03
Lisonbee - (30 days of flow data)				
Water Level (ft)	0.36	0.47	0.58	1.64
Flow ¹ (cfs)	1.97	4.48	18.78	159.61
Temperature (°C)	6.21	9.08	9.20	11.52
Conductivity (µs/cm)	230	386	395	519
TDS ² (mg/l)	150	251	257	337
Sodium Adsorption Ratio ³ (SAR)	0.69	1.19	1.21	1.60
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 April 2014, the water type at all three stations was a calcium bicarbonate water.

April 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).

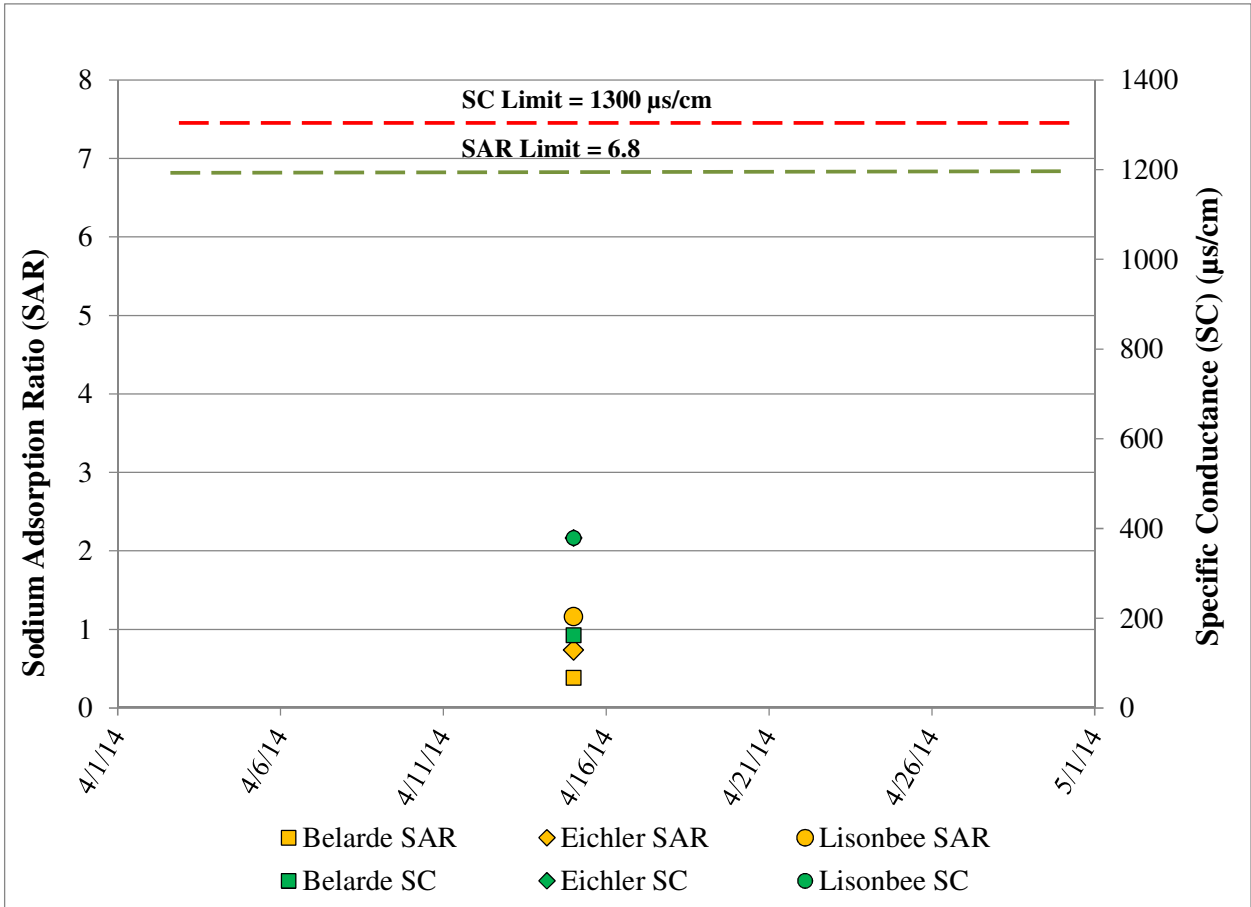


FIGURE 4
APRIL 2014 SPECIFIC CONDUCTANCE AND SAR

The water in April exhibits a range of hardness, with Belarde at 70 mg/l CaCO₃ hardness, Eichler at 119 mg/l CaCO₃ hardness, and Lisonbee at 137 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) concentrations in April 2014 were 34 mg/l at the Belarde station, 25.2 mg/l at the Eichler station, and 22 mg/l at the Lisonbee station (**Figure 5**). Total recoverable iron concentrations were 1.71 mg/l at Belarde, 1.38 mg/l at Eichler, and 0.662 mg/l at Lisonbee (**Figure 5**). Concentrations greater than 1 mg/l exceed chronic aquatic standard for total recoverable iron.

This is not unusual when elevated total suspended solids are present. **Figure 5** illustrates this correlation, with higher total recoverable iron values observed with higher total suspended solids values.

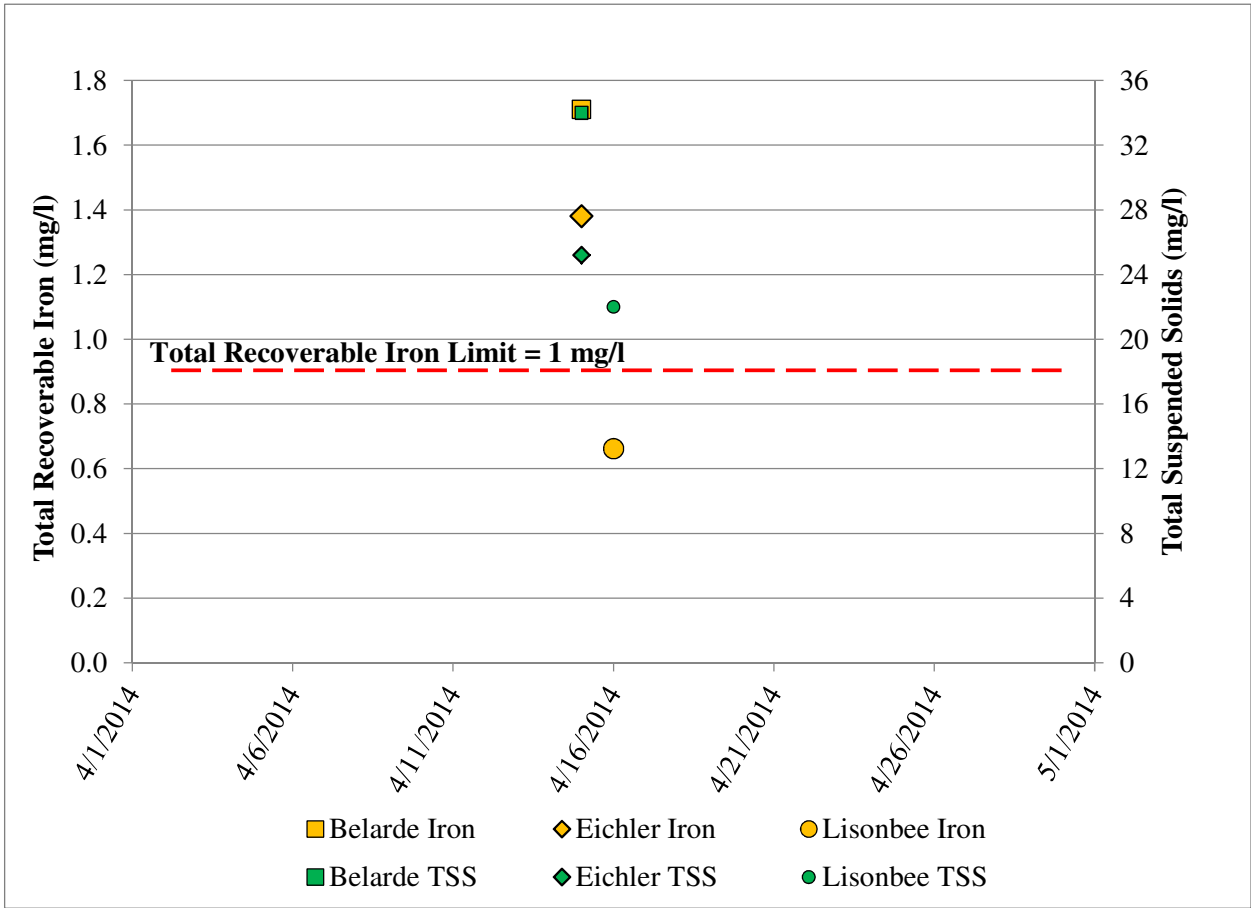


FIGURE 5
APRIL 2014 INSTANTANEOUS TOTAL RECOVERABLE IRON (MG/L) AND TOTAL SUSPENDED SOLIDS (MG/L)

Constituents below the detection limit at all three stations in April 2014 include arsenic, boron, chromium, copper, selenium, and zinc. 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 chronic potentially dissolved copper at all stations and acute potentially dissolved copper at the Belarde station was lower than the 15 µg/l detection limit (**Table 2**). Measured concentrations of potentially dissolved manganese 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 April 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, APRIL 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	4/15/2014	3a	70	9.6	6.6	1	2651	1465	116	88
Belarde Maximum April Results			NA	<15	<15	1.710	60.4	60.4	<20	<20
Eichler Hardness Based Standards	4/15/2014	3a	119	15.8	10.4	1	3164	1748	187	142
Eichler Maximum April Results			NA	<15	<15	1.380	311	311	<20	<20
Lisonbee Hardness Based Standards	4/15/2014	3a	137	18.1	11.7	1	3316	1832	213	161
Lisonbee Maximum April Results			NA	<15	<15	0.662	70.7	70.7	<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, APRIL 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	4/15/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Belarde Maximum April Results¹			<15	<0.05	<10	<10	<3	<4	<4	17.3	8.20	8.20
Eichler Standards	4/15/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Eichler Maximum April Results¹			<15	<0.05	<10	<10	9.74	<4	<4	28.8	8.19	8.19
Lisonbee Standards	4/15/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Lisonbee Maximum April Results¹			<15	<0.05	<10	<10	8.33	<4	<4	39.4	8.49	8.49

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>.