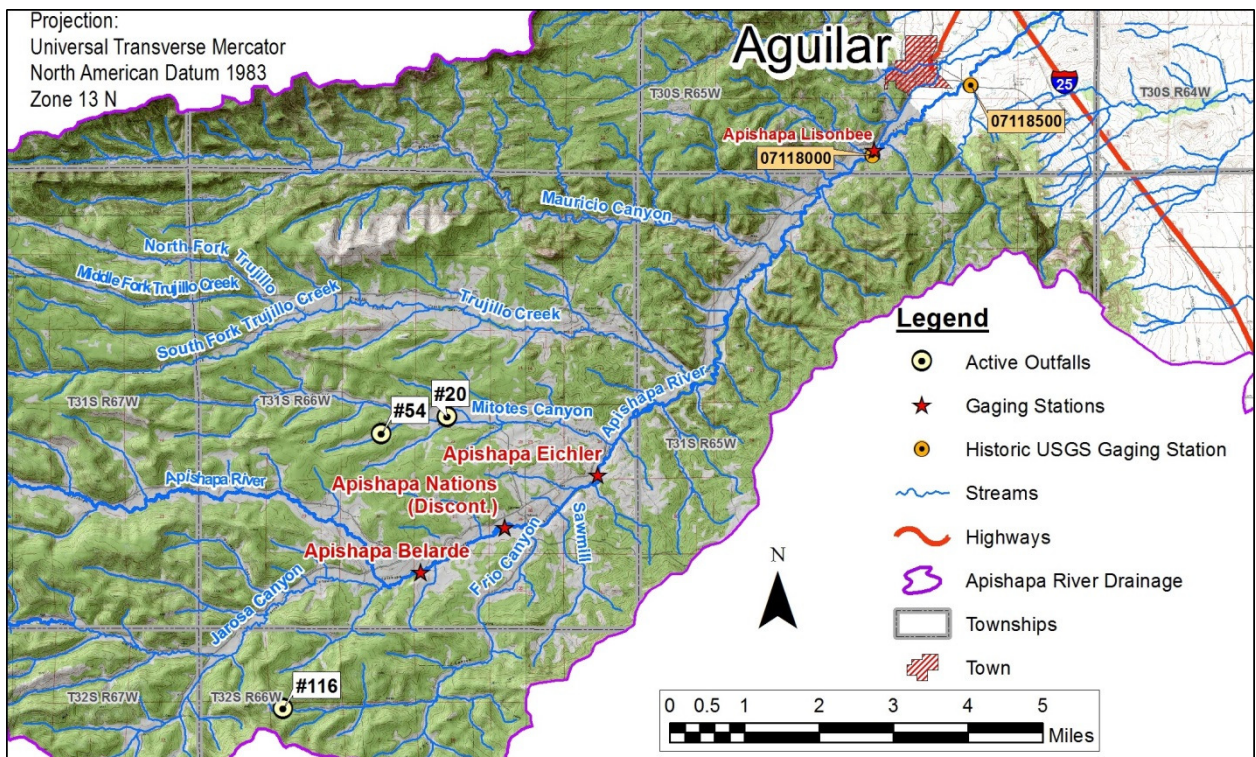


June 2014

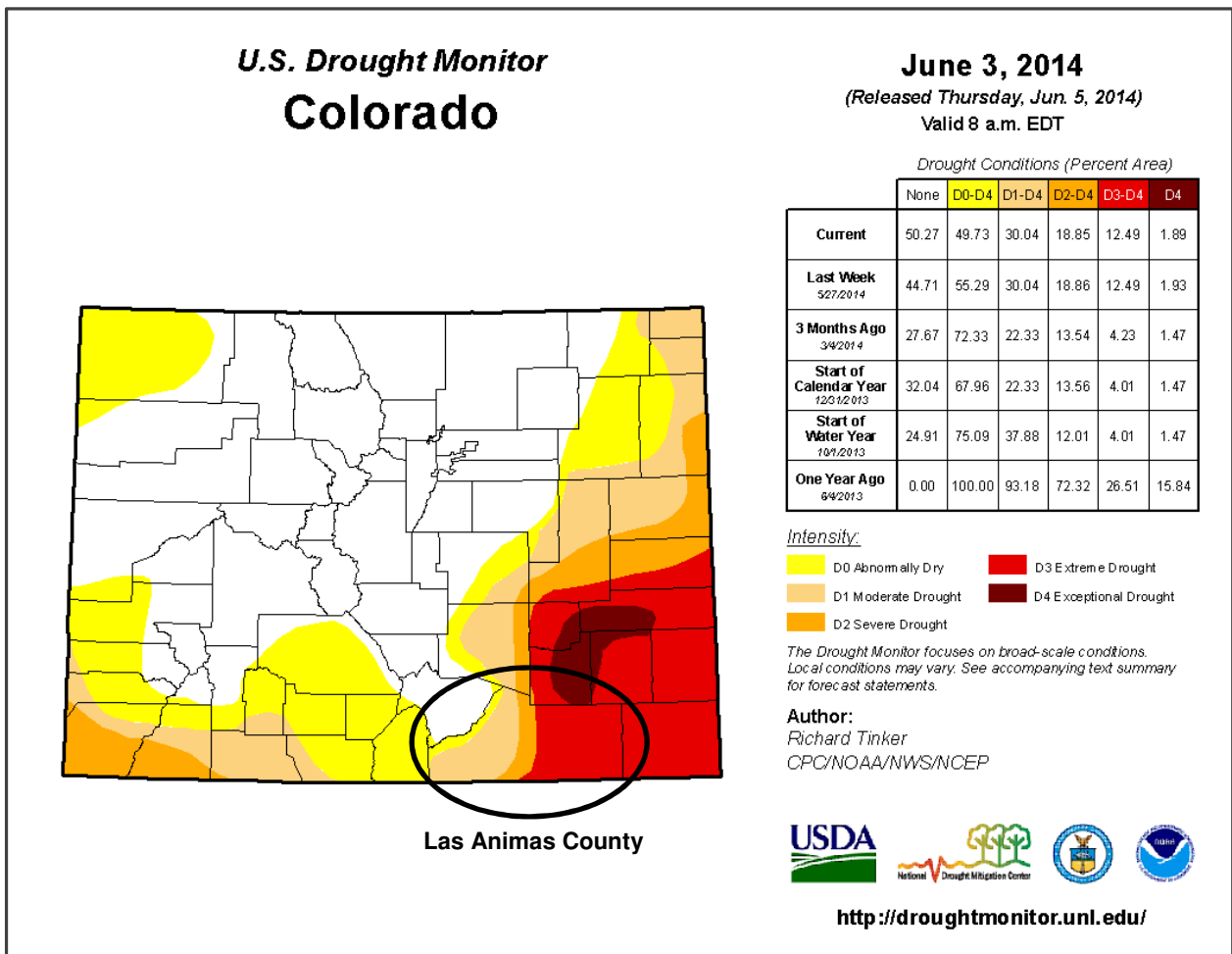
Norwest Corporation (Norwest) maintains three gaging stations for Pioneer Natural Resources USA Inc. (PNR) in the headwaters of the Apishapa River in northern Las Animas County, Colorado. The Apishapa River is a tributary of the Arkansas River. The gaging stations acquire “continuous” data on 15-minute 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](http://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.

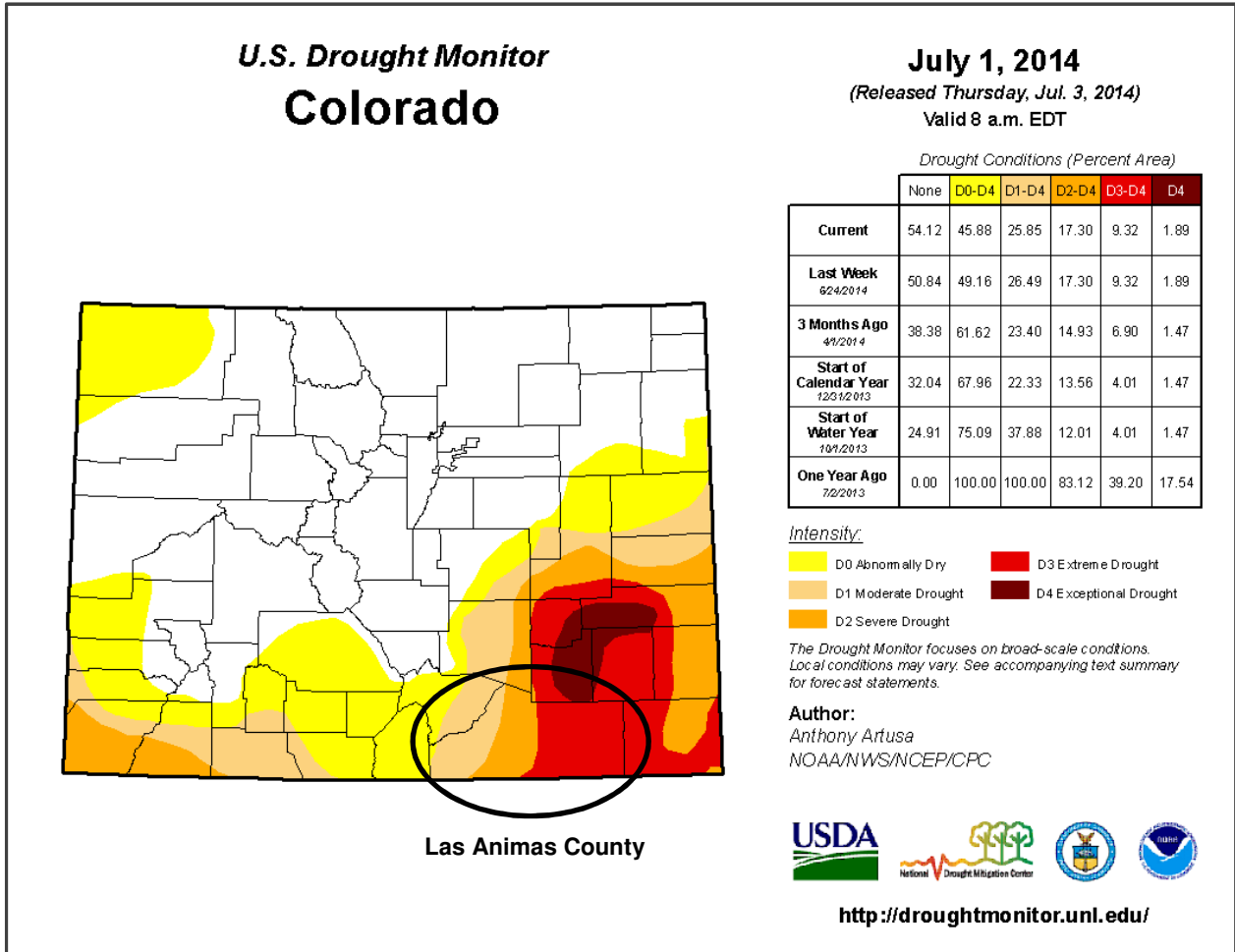


**FIGURE 1**  
**APISHAPA WATERSHED**

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 June 3, 2014. **Figure 3** depicts drought conditions in Colorado for data received as of 7 a.m. EST on July 1, 2014. The western portion of Las Animas County increased from a combination of D0 and D1 drought conditions in early June to mostly D1 and D2 drought conditions by July 1, 2014. The drought intensity for the central portion of Las Animas County increased from a combination of D1, D2, and D3 conditions to D2 and D3 drought conditions. D3 drought conditions remained throughout the month of June in the eastern part of the county (Drought Monitor, 2014).



**FIGURE 2**  
**U.S. DROUGHT MONITOR COLORADO – JUNE 3, 2014**



**FIGURE 3**  
**U.S. DROUGHT MONITOR COLORADO – JULY 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 and D2 drought conditions mentioned above. Recordable flow was present at all three stations the entire month of June 2014. Laboratory water quality samples were collected and streamflow was measured at all three stations during the two June 2014 site visits.

June 2014 data exhibited a calculated daily average flow of 3.55 cfs at Belarde, 2.95 cfs at Eichler, and 6.21 cfs at Lisonbee. Temperatures were seasonal. The daily average specific conductance at Belarde ranged from 76  $\mu\text{s}/\text{cm}$  to 332  $\mu\text{s}/\text{cm}$ , with a median value of 133  $\mu\text{s}/\text{cm}$  (**Table 1**). The daily average specific conductance at Eichler ranged from 205  $\mu\text{s}/\text{cm}$  to 516  $\mu\text{s}/\text{cm}$ , with a median value of 369  $\mu\text{s}/\text{cm}$  (**Table 1**). The daily average specific conductance at Lisonbee ranged from 288  $\mu\text{s}/\text{cm}$  to 661  $\mu\text{s}/\text{cm}$ , with a median value of 433  $\mu\text{s}/\text{cm}$  (**Table 1**). The calculated daily average sodium adsorption ratio (SAR) values in June 2014 ranged from 0.16 to 0.64 at Belarde, 0.25 to 1.14 at Eichler, and 0.86 to 2.02 at Lisonbee (**Table 1**).

**TABLE 1**  
**JUNE 2014 DAILY AVERAGE GAGE DATA**

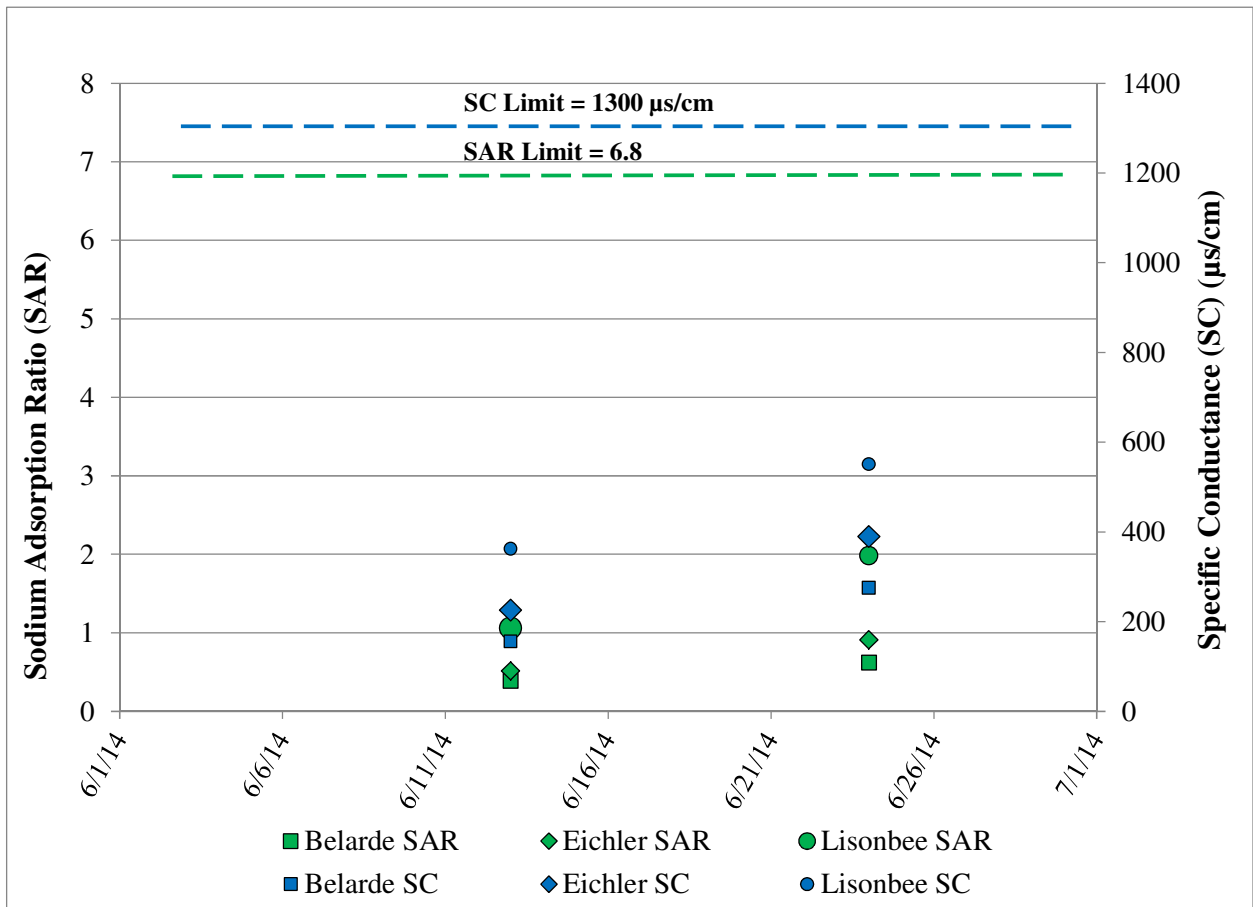
	Average Daily			
	Minimum	Median	Average	Maximum
<b>Belarde - (30 days of flow data)</b>				
Water Level (ft)	0.24	0.57	0.65	1.50
Flow <sup>1</sup> (cfs)	0.11	1.86	3.55	16.28
Temperature (°C)	13.92	16.70	16.76	19.92
Conductivity (µs/cm)	76	133	158	332
TDS <sup>2</sup> (mg/l)	50	86	103	216
Sodium Adsorption Ratio <sup>3</sup> (SAR)	0.16	0.36	0.38	0.64
<b>Eichler - (30 days of flow data)</b>				
Water Level (ft)	0.12	0.62	0.65	1.25
Flow <sup>1</sup> (cfs)	0.00	1.36	2.95	10.92
Temperature (°C)	14.99	17.44	17.35	19.63
Conductivity (µs/cm)	205	369	346	516
TDS <sup>2</sup> (mg/l)	133	240	225	335
Sodium Adsorption Ratio <sup>3</sup> (SAR)	0.25	0.80	0.72	1.14
<b>Lisonbee - (30 days of flow data)</b>				
Water Level (ft)	0.36	0.43	0.44	0.56
Flow <sup>1</sup> (cfs)	2.75	5.23	6.21	12.38
Temperature (°C)	14.67	16.93	16.74	18.29
Conductivity (µs/cm)	288	433	446	661
TDS <sup>2</sup> (mg/l)	187	281	290	430
Sodium Adsorption Ratio <sup>3</sup> (SAR)	0.86	1.32	1.36	2.02
<sup>1</sup> Calculated from pressure data				
<sup>2</sup> Calculated from conductivity data with a conversion of 0.65 mg/l TDS per µs/cm specific conductance				
<sup>3</sup> 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, 2014). During the month of June 2014, the water type at all three stations was a calcium bicarbonate water with a sodium bicarbonate water type at Lisonbee on June 24, 2014.

June 2014 field measured SC values and laboratory measured SAR values at the Belarde, Eichler, and Lisonbee stations are illustrated in **Table 2** and **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).

**TABLE 2**  
**JUNE 2014 SAR AND SPECIFIC CONDUCTANCE**

Location	Sample Date	SAR	Specific Conductance (µs/cm)
Belarde	6/13/2014	0.39	155.6
Belarde	6/24/2014	0.62	275.3
Eichler	6/13/2014	0.51	225.6
Eichler	6/24/2014	0.91	389.4
Lisonbee	6/13/2014	1.06	362.0
Lisonbee	6/24/2014	1.98	551.0



**FIGURE 4**  
**JUNE 2014 SAR AND SPECIFIC CONDUCTANCE**

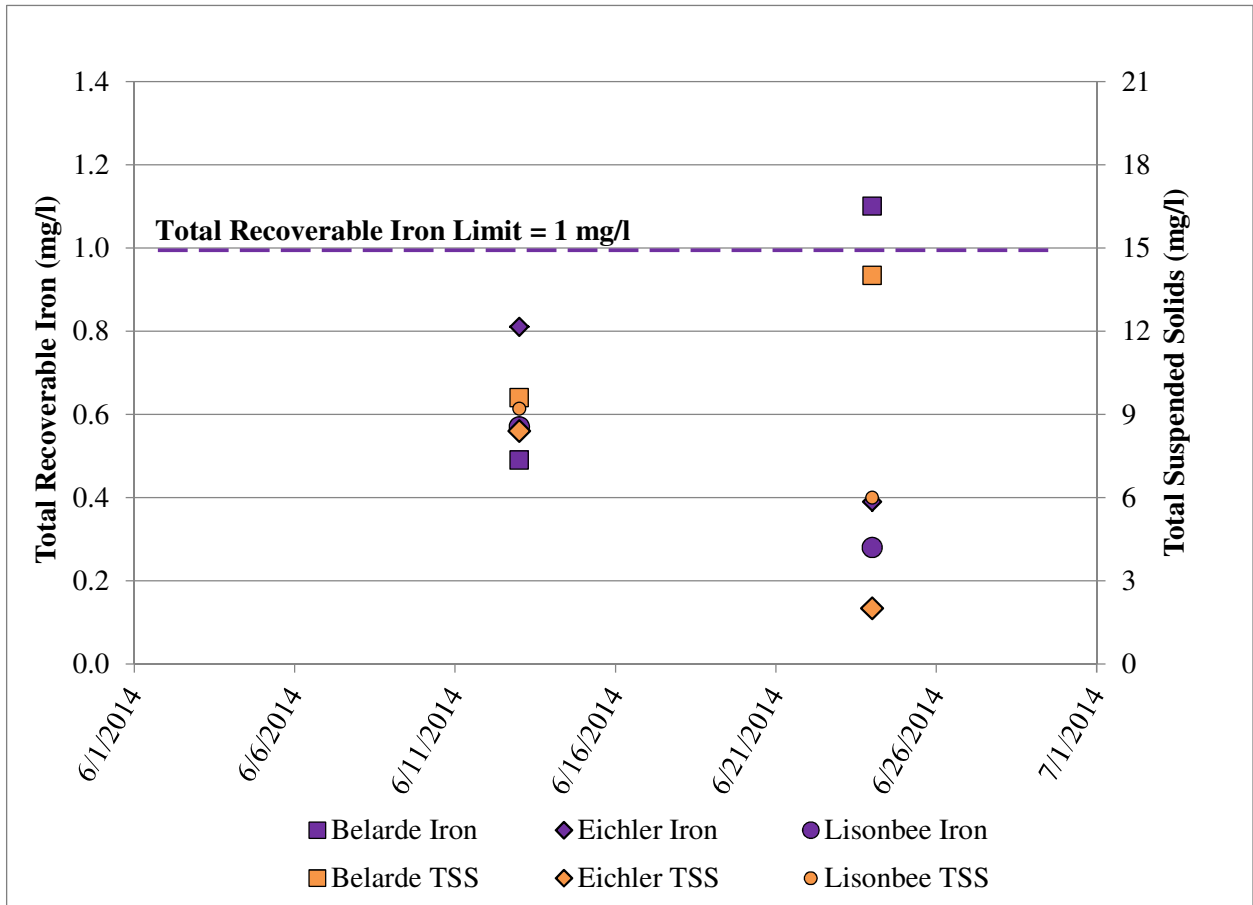
The water in June exhibits a range of hardness, with Belarde ranging from 75 mg/l CaCO<sub>3</sub> to 117 mg/l CaCO<sub>3</sub> hardness, Eichler ranging from 97 mg/l CaCO<sub>3</sub> to 165 mg/l CaCO<sub>3</sub> hardness, and Lisonbee ranging from 138 mg/l CaCO<sub>3</sub> to 186 mg/l CaCO<sub>3</sub> hardness (**Table 4**). Based on toxicity testing, aquatic species protection from elevated heavy metal concentrations increases as hardness increases (CDPHE WQCC, 2013). Lower hardness values, closer to 25 mg/l CaCO<sub>3</sub>, have lower hardness based metal

standards to provide aquatic life protection and higher hardness values, closer to 400 mg/l CaCO<sub>3</sub>, can afford higher hardness based metal standards to provide aquatic life protection (CDPHE WQCC, 2013).

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 June 2014 ranged from 9.6 mg/l to 14 mg/l at the Belarde station, ranged from <4 mg/l to 8.4 mg/l at the Eichler station, and ranged from 6 mg/l to 9.2 mg/l at the Lisonbee station (**Table 3** and **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 0.49 mg/l to 1.1 mg/l at Belarde, 0.39 mg/l to 0.81 mg/l at Eichler, and 0.28 mg/l to 0.57 mg/l at Lisonbee (**Table 3** and **Figure 5**).

**TABLE 3**  
**JUNE 2014 INSTANTANEOUS TOTAL RECOVERABLE IRON (MG/L) AND TOTAL SUSPENDED SOLIDS (MG/L)**

Location	Sample Date	Iron (T-Rec.) (mg/l)	Total Suspended Solids (TSS) (mg/l)
Belarde	6/13/2014	0.490	9.6
Belarde	6/24/2014	1.100	14.0
Eichler	6/13/2014	0.810	8.4
Eichler	6/24/2014	0.390	<4
Lisonbee	6/13/2014	0.570	9.2
Lisonbee	6/24/2014	0.280	6.0



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

Constituents below the detection limit at all three stations in June 2014 include arsenic, boron, copper, selenium, and zinc. Measured concentrations of potentially dissolved copper were below the detection limit of 15 µg/l at all three stations (**Table 4**). However, the hardness adjusted stream standard for chronic potentially dissolved copper at all stations except Lisonbee on June 24, 2014 and acute potentially dissolved copper at Belarde and Eichler on June 13, 2014 was lower than the 15 µg/l detection limit (**Table 4**). The acute and chronic total chromium standards were exceeded at Lisonbee on June 24, 2014 with a concentration of 790 µg/l. However, the method 200.7 metals (total recoverable) and method 200.8 metals (total recoverable) chromium levels from the same sample were non-detect at a reporting limit of 10 µg/l suggesting a laboratory error could have occurred resulting in an erroneous total chromium concentration (**Table 5**). Measured concentrations of potentially dissolved manganese were lower than the hardness adjusted stream standards established by the WQCC (**Table 4**). Chloride and sulfate were below the stream standards at the Belarde, Eichler, and Lisonbee stations (**Table 5**). The field pH values in June 2014 were within the stream standard of between 6.5 and 9.0 at all three stations (**Table 5**).

**TABLE 4**

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

Site	Sample Date	Stream Segment	Calculated Hardness <sup>1</sup> (mg/l CaCO <sub>3</sub> )	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	6/13/2014	3a	75	10.2	7.0	1	2713	1499	123	93
Belarde Hardness Based Standards	6/24/2014	3a	117	15.6	10.2	1	3146	1738	185	140
<b>Belarde Maximum June Results</b>			<b>NA</b>	<b>&lt;15</b>	<b>&lt;15</b>	<b>1.10</b>	<b>78</b>	<b>78</b>	<b>&lt;20</b>	<b>&lt;20</b>
Eichler Hardness Based Standards	6/13/2014	3a	97	13.1	8.7	1	2956	1633	156	118
Eichler Hardness Based Standards	6/24/2014	3a	165	21.5	13.7	1	3528	1949	252	191
<b>Eichler Maximum June Results</b>			<b>NA</b>	<b>&lt;15</b>	<b>&lt;15</b>	<b>0.81</b>	<b>150</b>	<b>150</b>	<b>&lt;20</b>	<b>&lt;20</b>
Lisonbee Hardness Based Standards	6/13/2014	3a	138	18.2	11.8	1	3324	1836	214	162
Lisonbee Hardness Based Standards	6/24/2014	3a	186	24.1	15.2	1	3671	2028	281	213
<b>Lisonbee Maximum June Results</b>			<b>NA</b>	<b>&lt;15</b>	<b>&lt;15</b>	<b>0.57</b>	<b>54</b>	<b>54</b>	<b>&lt;20</b>	<b>&lt;20</b>

<sup>1</sup> A hardness value of 400 mg/l CaCO<sub>3</sub> is used to calculate the metal standards when the measured hardness values are greater than 400 mg/l CaCO<sub>3</sub>



**TABLE 5**

**STREAM STANDARDS ASSOCIATED WITH APISHAPA RIVER INSTANTANEOUS SAMPLING, JUNE 2014 (CDPHE WQCC, 2013)**

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	6/13/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Belarde Standards	6/24/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
<b>Belarde Maximum June Results<sup>1</sup></b>			<b>&lt;15</b>	<b>&lt;0.05</b>	<b>&lt;10</b>	<b>&lt;10</b>	<b>4.5</b>	<b>&lt;4</b>	<b>&lt;4</b>	<b>25</b>	<b>7.99</b>	<b>8.11</b>
Eichler Standards	6/13/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Eichler Standards	6/24/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
<b>Eichler Maximum June Results<sup>1</sup></b>			<b>&lt;15</b>	<b>&lt;0.05</b>	<b>&lt;10</b>	<b>&lt;10</b>	<b>14</b>	<b>&lt;4</b>	<b>&lt;4</b>	<b>20</b>	<b>8.20</b>	<b>8.27</b>
Lisonbee Standards	6/13/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Lisonbee Standards	6/24/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
<b>Lisonbee Maximum June Results<sup>1</sup></b>			<b>&lt;15</b>	<b>&lt;0.05</b>	<b>790<sup>2</sup></b>	<b>790<sup>2</sup></b>	<b>8.8</b>	<b>&lt;4</b>	<b>&lt;4</b>	<b>52</b>	<b>8.28</b>	<b>8.39</b>

<sup>1</sup> Minimum result identified for pH-low

<sup>2</sup> Result of Method 200.7 Metals (Total). Method 200.7 Metals (Total Recoverable) and Method 200.8 Metals (Total Recoverable) were both non-detect at a reporting limit of 10 µg/l.

## References

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