COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

1313 Sherman Street, Room 215
Denver, CO 80203

August 6, 2018

Chris Gilbreath
Tri-State Generation and Transmission Association
1100 West 116th Avenue
Westminster, CO 80234

Re: Colowyo Coal Company, Permit No. C-81-019
Review of 2017 Annual Hydrology Report (AHR)

Dear Mr. Gilbreath:

The Division has reviewed the 2017 AHR for the Colowyo Mine in the context of Rules 4.05.1, 4.05.6, 4.05.11, and 4.05.13 (Regulations of the Colorado Mined Land Reclamation Board for Coal Mining).

Table 1 lists four important logistical requirements of the Colowyo Mine water monitoring plan, and indicates if the requirement was met in 2017.

Table 1 Requirements of the Colowyo Mine Water Monitoring Plan

Requirement	Regulation or other source of requirement	Requirement met for 2017?
Filing frequency of AHR - annually	Rule 4.05.13(4)(c)	yes
Timely filing of hydrology report – submitted by March 15 each year.	Section 2.04.13 of the Colowyo Mine PAP.	yes
Sites sampled and sampling frequency at surface water monitoring sites	Section 4.05.13 of PAP (Collom Rule 4)	yes
Parameters sampled at surface water monitoring sites	Section 4.05.13 of PAP (Collom Rule 4)	yes
Sites sampled and sampling frequency at groundwater monitoring sites	Section 4.05.13 of PAP (Collom Rule 4)	yes
Parameters sampled at groundwater monitoring sites	Section 4.05.13 of PAP (Collom Rule 4)	yes

In past reviews of AHRs, DRMS has asked Colowyo Coal Company to assess the water quality data, especially in light of the Probable Hydrologic Consequences (PHC) in the Colowyo Mine PAP. In the 2017 AHR (and past AHRs), Colowyo Coal Company has included discussions of temporal trends of key parameters at each sampling location. This is a worthwhile exercise, however DRMS believes that a thorough assessment of water quality conditions and potential impacts requires two other components:

- Analyses of spatial trends, comparing upstream data to downstream data (sampling locations above and below the mine) to the extent possible.
- A comparison to CDPHE (WQCC) standards for receiving waters below the mine.

With this in mind, the following analyses were conducted by DRMS based on the data provided in the 2017 AHR for the Colowyo Mine. **Colowyo Coal Company should provide a response to the following analyses (in particular, potential water quality issues that are raised by the Division) and provide similar analyses in future AHRs**.

REVIEW OF SURFACE WATER QUALITY DATA

There are three creeks below the current Colowyo Mine. These include Good Spring Creek, Taylor Creek, and Wilson Creek. There is little or no water quality data for Wilson Creek. (Monitoring is required in the future if mining begins in the Wilson Creek area.) It is assumed that there are no significant impacts below the Collom Mine at this time. In addition, no flow has been detected in Lower Collom Gulch (LCG sampling location) since Colowyo Coal Company has been sampling (beginning in 2011). Therefore, the following analysis is focused on Taylor and Good Spring Creeks.

The CDPHE standards used for the analysis of the two primary receiving waters below Colowyo were found in the following segments from Regulation #37:

- Segment 3c. for Taylor Creek (a tributary to Milk Creek)
- Segment 3e. for Good Spring Creek.

Table 2 includes standards for several parameters. These are the parameters of primary interest based on DRMS review of AHRs and Discharge Monitoring Reports, review of USGS data for the Yampa River, and consideration of water use. Standards are commonly based on the designated use of the water. The DWR database of water rights was reviewed to determine if water from any of the creeks is being used for the designation Water Supply. The search included domestic, household, and municipal uses, and for structures included (but was not limited to) reservoirs, wells, and ditches. It was found that there is no apparent use of the water in the creeks and connected alluvia for domestic use or other Water Supply (WS) uses except by Colowyo itself. (When considering the impacts of the Colowyo Mine on uses of the receiving waters, Colowyo's own use of the water was not considered relevant.) Therefore, analyses of sulfate, dissolved iron, and other parameters associated with a WS standard were not conducted, and standards for these parameters are not included in the table.

Table 2 CDPHE Water Quality Standards/Guidelines for Taylor and Good Spring Creeks

Parameter	Taylor Creek Standard	Good Spring Creek Standard
Total Dissolved Solids	1,500 mg/l	1,500 mg/l
Total Recoverable Iron	1.0 mg/l	1.0 mg/l
Dissolved Manganese	1,563 µg/l	1,563 µg/l
Dissolved Selenium	4.6 µg/l	4.6 µg/l
Ammonia Nitrogen	0.16 mg/l	0.16 mg/l

Notes: TDS values are guidelines rather than standards.
For dissolved selenium, 4.6 µg/l is chronic standard. Acute standard of 18.4 µg/l also considered.
Ammonia nitrogen is often less stringent, as it is dependent on temperature and pH (the value of 0.16 mg/l is conservatively low).

TDS concentrations were compared to the guideline of 1,500 mg/l, because of the presence of irrigation agriculture beside the creeks. The DWR database indicates that there are several water rights with both Taylor Creek and Good Spring Creek as sources and irrigation as the use. Based on a 1983 document produced by the Office of Surface Mining Reclamation and Enforcement (OSM) that draws on research by the Environmental Protection Agency and the National Academy of Science and classifies irrigation hazards by TDS content, DRMS set a guideline of 750 mg/l as a maximum target level for TDS for crops in most watersheds (Banta, 1988). However, for the types of crops that are grown and will likely be grown in the future in the study area for the Yampa River CHIA (e.g., alfalfa), a less stringent guideline of 1,500 mg/l is considered appropriate. This is supported by the following references: Sanden and Sheesley (2007), Bauder et. al, (revised 2014), and Hill and Koenig (1999). (These references can be provided upon request.)

The water quality standards (and TDS guideline) were compared to the data summaries on pages 6 and 7 of the 2017 AHR for Colowyo and the surface water data tables in Exhibit 1A of the 2017 AHR (labeled Exhibit 2A – **a discrepancy to fix in future AHRs**).

<u>Taylor Creek</u>

The sampling site below Colowyo on Taylor Creek is LTC. Based on a comparison of LTC data and standards in Segment 3c., the only potential issue related to the CDPHE standards is total iron, with several concentrations above the standard of 1.0 mg/l. However, total iron is not considered a problem in Taylor Creek because the trend line in the 2017 AHR (page 125) indicates that concentrations have actually decreased over the last 30 years. Although there was some Colowyo Mine influence in the Taylor Creek watershed (facilities area and Work Area pond) going back to the early 1980s (more than 30 years ago), the majority of the influence occurred later. The West Pit Pond, for example, was not built until circa 1997. Therefore, it is apparent that the Colowyo Mine has not had a negative impact on this creek in terms of total iron, or in terms of other water quality parameters with standards in Regulation 37.

Regarding TDS at LTC, the summary table from the 2017 AHR shows a maximum value of 2,910 mg/l, and the graph of TDS concentrations from 1983 to 2017 shows a distinct rise over time, with older concentrations mostly below the guideline of 1,500 mg/l and most recent concentrations well above 1,500 mg/l (Figure 1 in Appendix 1). Table 2.04.7-34 in the Colowyo Mine PAP (Baseline Surface Water Monitoring Data) indicates that baseline concentrations for LTC were 1,180 and 1,210 mg/l.

To assess the source of TDS in Taylor Creek, recent DMRs were reviewed. Beginning in the first quarter of 2015 and ending the first quarter of 2018, all of the measured concentrations discharging from the Work Area Pond, East Taylor Pond, and West Taylor Pond were above 1,500 mg/l. Of particular significance are concentrations from East Taylor Pond (Outfall 010A in the CDPS permit). Every quarter since 2015 has had a recorded TDS concentration for this outfall (no "no discharge" results were recorded for this outfall), and all of the values were above 3,000 mg/l. **It is very likely that discharges from Colowyo are a significant source of TDS in this creek, a contributor to high levels of TDS, and potentially causing material damage to the receiving water. Please discuss this in your response, especially in the context of the PHC in the PAP and Rule 4.05.1.**

Good Spring Creek

The monitoring site below Colowyo on Good Spring Creek is LGSC. Based on a comparison of LGSC data (in the 2017 AHR) and standards in Segment 3e, the following potential issues were identified:

- There was a pH value below 6.1.
- Several total iron concentrations above 1.0 mg/l were recorded.

However, these potential issues are not considered problematic for the following reasons:

- There was only one lab pH value below the low standard of 6.5, and it occurred in 1991.
- Total iron is not a problem since the upstream concentrations (monitoring location UWFGSC) are generally higher than downstream (mine impacted) concentrations. As shown in the summary tables in the 2017 AHR, the mean of the upstream total iron concentrations is 1.43 mg/l, and the mean downstream is 0.63 mg/l. The maximum of the

upstream total iron concentrations is 9.86 mg/l, and the maximum downstream is 8.84 mg/l.

Regarding TDS in Good Spring Creek, the summary tables from the 2017 AHR show a maximum value of 4,050 mg/l at the downstream site (LGSC), but much lower upstream (910 mg/l at UWFGSC and 1,610 mg/l at NUGSC). The increasing trend from upstream to downstream can also be seen in the mean values: mean concentrations increase from 691 mg/l at the upper end (UWFGSC) to 1,354 mg/l at the downstream end of the permit area (LGSC).

The graph of TDS concentrations from 1982 to 2017 shows a slight rise over time at LGSC, with older concentrations (prior to 1985) all below the guideline of 1,500 mg/l and many recent concentrations above 1,500 mg/l, some approaching 2,000 mg/l (Figure 2 in Appendix 1).

To assess the source of TDS in Good Spring Creek, recent DMRs were reviewed. Since the first quarter of 2015, all of the measured concentrations discharging from Streeter Pond were above 1,500 mg/l, and most were above 2,000 mg/l. **Therefore, it is very likely that discharges from Colowyo are a significant source of TDS in this creek, a contributor to high levels of TDS, and potentially causing material damage to the receiving water. Please discuss this in your response, especially in the context of the PHC in the PAP and Rule 4.05.1.**

REVIEW OF GROUNDWATER QUALITY DATA

Alluvial groundwater data from downdip wells was compared to CDPHE's Regulation 41 standards (Appendix 2) and, as needed, up-gradient well data. Data for the following downdip wells were reviewed:

- A-7 Well – located in the alluvium of Good Spring Creek below the South Taylor Pit operations. (The potential for mining impacts in this well is low because of the eastern limits of the East Pit.)
- North Good Springs Well (NGSW) – located in the alluvium of Good Spring Creek below Streeter Fill and other mine operations.
- Gossard Well – located below the rail loop facility in the Wilson Creek alluvium.
- MT-95-02 – located in the alluvium of Taylor Creek below mining activities and above the loadout.

As with the surface water analysis, it is assumed that there are no significant groundwater impacts below the Collom Mine at this time.

<u>A-7 Well</u>

In well A-7, some concentrations of lead, selenium, and TDS exceed the standards and TDS guidance, therefore these parameters were analyzed further.

Lead values are all 0.2 mg/l (likely the detection limit) and all exceed the standard (0.05 mg/l for human health). However, concentrations have not changed over the last 10 years, and concentrations at the up-gradient well A-8 are also 0.2 mg/l, indicating that the mine is not likely causing an issue with this parameter in this well.

Some selenium values exceed the Agricultural standard of 0.02 mg/l, but there is only one exceedance since 2011. The mean from 2008 – 2017 is 0.01 mg/l and the maximum was 0.042 mg/l in 2008. During the same time frame, concentrations in the up-gradient well A-8 are very similar with a mean of 0.01 mg/l and a maximum of 0.035 mg/l, indicating that the mine is not likely causing an issue with this parameter in this well.

TDS values are almost all below 1,500 mg/l in the A-7 well, and there has been little increase over last 10 years. Also, concentrations in the up-gradient well A-8 are very similar, indicating that the mine is not likely causing an issue with this parameter in this well.

North Good Springs Well (NGSW)

Lead concentrations are all 0.2 mg/l and all exceed the standard (0.05 mg/l for human health). However, concentrations have not changed over the last 14 years, and concentrations at the up-gradient well A-6 are also 0.2 mg/l, indicating that the mine is not likely causing an issue with this parameter in this well.

Manganese concentrations in NGSW have been routinely above the Agricultural standard of 0.2 mg/l, with a mean of 0.57 mg/l and maximum of 1.32 mg/l. These values are significantly above the concentrations in Well A-6 above the mine in the Good Springs alluvium (mean of 0.05 mg/l and maximum of 0.16 mg/l).

TDS concentrations in NGSW are almost all above 1,500 mg/l, whereas the concentrations above the mine, in Well A-6, are all below 1,500 mg/l. Some particular statistics from the data:

- The mean concentration of TDS for NGSW is 1,670 mg/l, with a maximum of 2,190 mg/l. (Period of record is 1989 to 2017.)
- The mean concentration of TDS for A-6 is 696 mg/l, with a maximum of 930 mg/l. (Period of record is 1984 to 2017.)

Also there is a distinct increase in this concentration over time. In Exhibit 2B (page 239), the average TDS concentration (per the trend line) increases from approximately 1,450 mg/l to approximately 1,900 mg/l. If 1,450 mg/l was considered “background,” the increase would be approximately 31 percent.

The Colowyo Mine appears to be adversely impacting the alluvium of Good Spring Creek, as seen with concentrations of manganese and TDS. Please discuss this in your response.

<u>Gossard Well</u>

Lead concentrations in the Gossard Well have all been 0.2 mg/l since year 2005. These concentrations exceed the standard (0.05 mg/l) for human health. Prior to 2005, the recorded lead concentrations were generally an order of magnitude lower. A change in laboratory techniques and a higher detection limit could be the cause of this change, but **please discuss this in your response**.

Since the year 2001, the recorded TDS concentrations in this well have all been over 1,500 mg/l. Baseline data from upgradient well MW-95-02 shows TDS concentrations all below 1,500 mg/l, suggesting that Colowyo Mine has contributed to increased concentrations of TDS in the Wilson Creek alluvium. **Please discuss this in your response.**

<u>MT-95-02 Well</u>

Recorded lead concentrations are all 0.2 mg/l, as in other wells. **Please discuss this in conjunction with the related discussion for the Gossard Well.**

Recorded TDS concentrations (period of record from 2008 to 2017) are all above 2,000 mg/l. Baseline data from upgradient well MT-95-01 shows TDS concentrations all below 1,500 mg/l, suggesting that Colowyo Mine has contributed to increased concentrations of TDS in the Taylor Creek alluvium. **Please discuss this in your response.**

I look forward to seeing your responses to this letter, or please contact me, Zach Trujillo, or Jason Musick to discuss the possibility of a conference call or meeting to discuss these matters.

Sincerely,

Robert D. Zuber

Robert D. Zuber, P.E.
Environmental Protection Specialist II

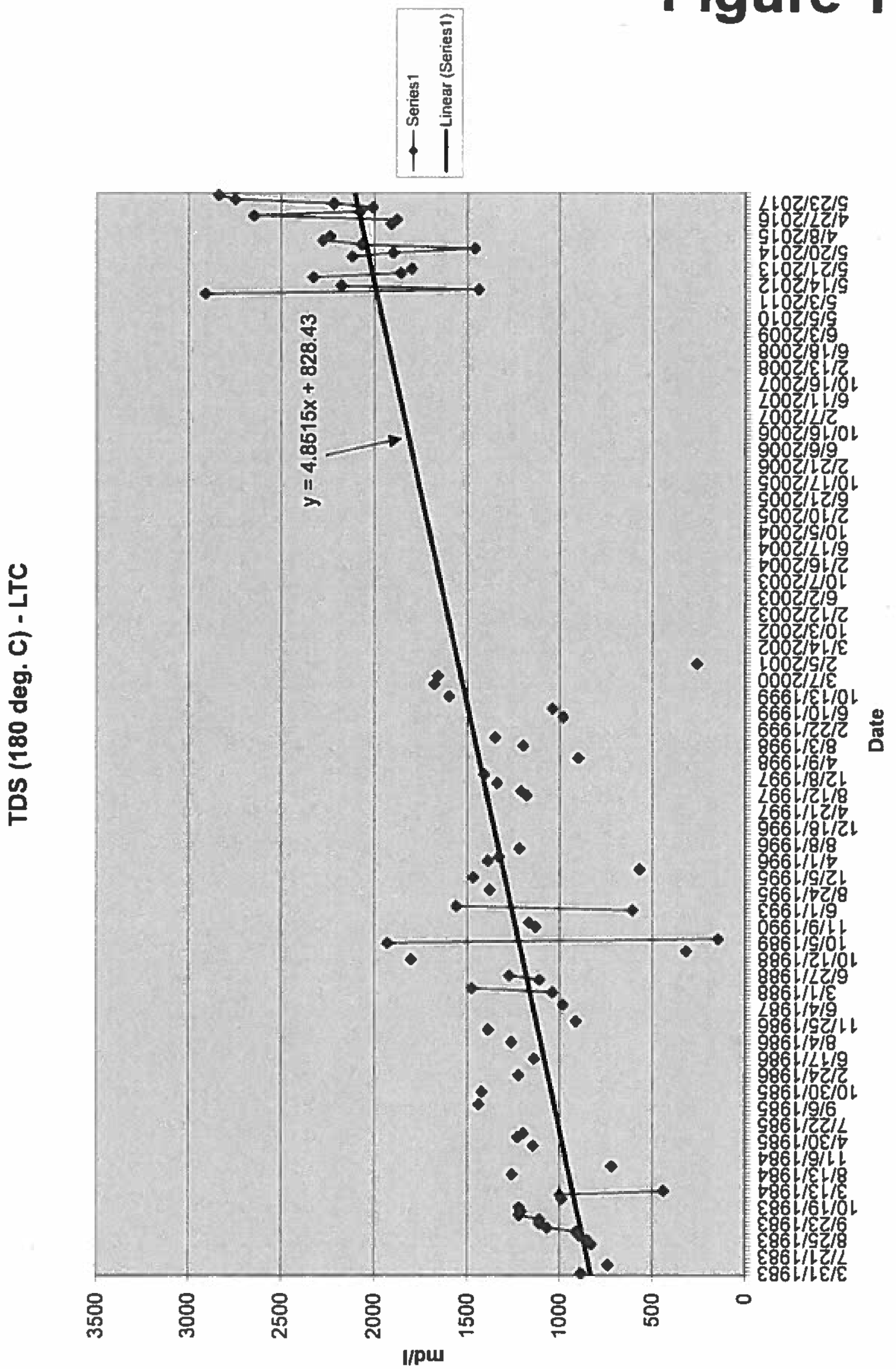
Cc: Tony Tennyson, Tri-State Generation and Transmission Association
Jason Musick and Zach Trujillo, DRMS

APPENDIX 1

FIGURES

Figure 1

Exhibit 2A



LTC

Exhibit 2A

TDS (180 deg. C) - LGSC

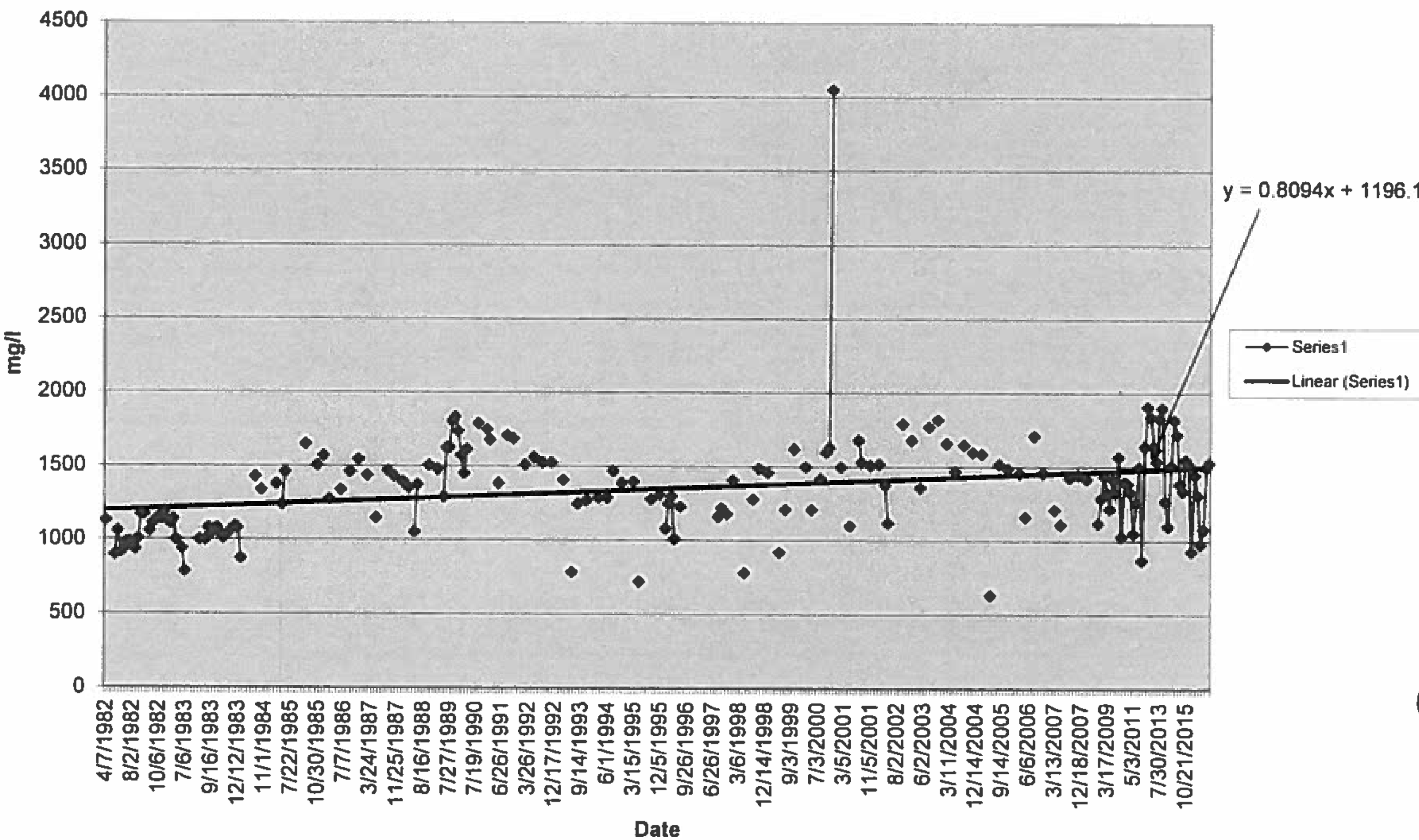


Figure 2

LGSC

APPENDIX 2

REGULATION 41 STANDARDS

The provisions of these regulations are severable, and if any provisions or the application of the provisions to any circumstances is held invalid, the application of such provision to other circumstances, and the remainder of these regulations, shall not be affected thereby.

TABLE 1 Domestic Water Supply – Human Health Standards	
Parameter	**Standard**[1]
Biological	
Total Coliforms (30 day average)	2.2 [a]org/100 ml
Total Coliforms (max in 30 days)	23org/100 ml
Inorganic	
Antimony (Sb)[d, M]	0.006mg/l
Asbestos [M]	7,000,000fibers/Liter
Arsenic (As)[d, M]	0.01mg/l
Barium (Ba)[d, M]	2.0mg/l
Beryllium (Be)[d, M]	0.004mg/l
Cadmium (Cd)[d, M]	0.005mg/l
Chromium (Cr)[c, d, M]	0.1mg/l
Cyanide [Free] (CN)[M]	0.2mg/l
Fluoride (F)[d, M]	4.0mg/l
Lead (Pb)[d]	0.05mg/l
Mercury (inorganic) (Hg)[d,M]	0.002mg/l
Molybdenum (Mo) [d]	0.035mg/l
Nickel (Ni)[d]	0.1mg/l
Nitrate (NO3)[d, M]	10.0mg/l as N
Nitrite (NO2)[d, M]	1.0mg/l as N
Total Nitrate+Nitrite (NO_2+NO_3-N)[d, f]	10.0mg/l as N
Selenium (Se)[d, M]	0.05mg/l
Silver (Ag)[d]	0.05mg/l
Thallium (Tl)[d, M]	0.002mg/l
Uranium (U) [d, M]	0.03mg/l
Radiological[b, d]	
Gross Alpha Particle Activity[i, M]	15 pCi/l
Beta and Photon Emitters[e]	4 mrem/year

TABLE 2
Domestic Water Supply – Drinking Water Standards

Parameter	**Standard**
Chlorophenol	0.0002 mg/l
Chloride (Cl)[d]	250 mg/l
Color	15 color units

TABLE 2
Domestic Water Supply – Drinking Water Standards

Copper (Cu)[d]	1 mg/l
Corrosivity	Noncorrosive
Foaming Agents	0.5 mg/l
Iron (Fe)[d]	0.3 mg/l
Manganese (Mn)[d]	0.05 mg/l
Odor	3 threshold odor numbers
pH	6.5 - 8.5
Phenol	0.3 mg/l
Sulfate (SO_4)[d]	250 mg/l
Zinc (Zn)[d]	5 mg/l

Table 3
Agricultural Standards

Parameter	**Standard**
Aluminum (Al)[d, f]	5 mg/l
Arsenic (As)[d]	0.1 mg/l
Beryllium (Be)[d]	0.1 mg/l
Boron (B)[d, g]	0.75 mg/l
Cadmium (Cd)[d]	0.01 mg/l
Chromium (Cr)[d]	0.1 mg/l
Cobalt (Co)[d]	0.05 mg/l
Copper (Cu)[d]	0.2 mg/l
Fluoride (F)[d]	2 mg/l
Iron (Fe)[d]	5 mg/l
Lead (Pb)[d, f]	0.1 mg/l
Lithium (Li)[d, h]	2.5 mg/l
Manganese (Mn)[d, i]	0.2 mg/l
Mercury (Hg)[d, f]	0.01 mg/l
Nickel (Ni)[d]	0.2 mg/l
Nitrite (NO2-N)[d, f]	10 mg/l as N
Nitrite & Nitrate(NO2 +NO3-N)[d, f]	100 mg/l as N
Selenium (Se)[d]	0.02 mg/l
Vanadium (V)[d]	0.1 mg/l
Zinc (Zn)[d]	2 mg/l
pH	6.5 - 8.5

TABLE 4
TDS Water Quality Standards

Background TDS Value (mg/l)	**Maximum Allowable TDS Concentrations**
0 - 500	400 mg/l or 1.25 times the background level, whichever is least restrictive

TABLE 4

TDS Water Quality Standards

501 - 10,000	1.25 times the background value
10,001 or greater	No limit

[1] Chronic or 30-day standard based on information contained in EPA's Integrated Risk Information System (IRIS) using a 10^{-6} incremental risk factor.

[a]. When the Membrane Filter Technique is used for analysis, the average of all samples taken within thirty days must be less than 1 organism per 100 milliliters of sample. When the Multiple Tube Fermentation Method is used for analysis, the limit is less than 2.2 org/100 ml.

[b]If the identity and concentration of each radionuclide in a mixture are known, the limiting value would be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit specified. The sum of such ratios for all radionuclides in the mixture shall not exceed "1" (i.e. unity). A radionuclide may be considered as not present in a mixture if the ratio of the concentration to the limit does not exceed 1/10 and the sum of such ratios for all radionuclides considered as not present in the mixture does not exceed 1/4.

[c]The chromium standard is based on the total concentration of both trivalent and hexavalent forms of dissolved chromium.

[d]Measured as dissolved concentration. The sample water shall be filtered through a 0.45 micron membrane filter prior to preservation. The total concentration (not filtered) may be required on a case-by-case basis if deemed necessary to characterize the pollution caused by the activity.

[e]If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem per year. Except for Tritium and Strontium 90 the concentration of man-made radionuclides causing 4 mrem total body or organ dose equivalents shall be calculated on the basis of a 2 liter per day drinking water intake using the 168-hour data listed in "Maximum Permissible Body Burden and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," NBS Handbook 69, as amended, August 1963, US Department of Commerce.

[f]These more stringent levels are necessary to protect livestock watering. Levels for parameters without this footnote are set to protect irrigated crops at the same level. Where a party can demonstrate that a livestock watering use of ground water is not reasonably expected, the applicable standard for lead is 5.0 mg/l.

[g]This level is set to protect the following plants in ascending order of sensitivity: Pecan, Black Walnut, Persian (English) Walnut, Jerusalem Artichoke, Navy Bean, American Elm, Plum, Pear, Apple, Grape (Sultanina and Malaga), Kadota Fig, Persimmon, Cherry, Peach, Apricot, Thornless Blackberry, Orange, Avocado, Grapefruit, Lemon. Where a party can demonstrate that a crop watering use of ground water is not reasonably expected, the applicable standard for boron is 5.0 mg/l.

[h]This level protects all crops, except citrus which do not grow in Colorado and therefore a more stringent level of protection is not required.

[i]The Gross Alpha Activity standard excludes alpha activity due to Radon and Uranium.

[j] This standard is only appropriate where irrigation water is applied to soils with pH values lower than 6.0.

[M]Drinking water MCL.

41.9 Reserved.

41.10 Reserved.

41.11 Reserved.

41.12 STATEMENT OF BASIS AND PURPOSE

Statement of Basis and Purpose for adopting the Regulations entitled: "The Basic Standards for Ground Waters". In accordance with 24-4-103(4), CRS (1982 and 1985 Supp.), the Commission adopts this Statement of Basis and Purpose.

PURPOSE

"The Basic Standards for Ground Waters" establishes a system of classifications (classes) for determining the appropriate degree of protection (standards) necessary to maintain beneficial uses of ground waters. These standards and classes are intended to complement regulations 3.1.0, "The Basic Standards and Methodologies" which are primarily applicable to surface waters. Together, regulations 3.1.0 and 3.11.0 protect all state waters as defined in Section 25-8-203, CRS (1982). Separate regulations for surface and