



APPENDIX I

Preliminary Effluent Limits: (WQA-2008)



**WATER QUALITY ASSESSMENT
BOXELDER CREEK AND CACHE LA POUFRE RIVER
BOXELDER SANITATION DISTRICT WWTF**

RECEIVED
JUL 09 2008

BOXELDER SANITATION DISTRICT

Table 1 Assessment Summary	
Name of Facility	Boxelder Sanitation District WWTF
CDPS Number	CO-0020478
Stream Segment - WBID	South Platte River Basin, Cache La Poudre Sub-basin, Stream Segment 13b: Mainstem of Boxelder Creek from its source to the confluence with the Cache La Poudre River. - COSPCP13b
Classifications	Aquatic Life Warm 2 Recreation 1b (5/15 – 9/15) Recreation 2 (9/16-5/14) Agriculture
Designation	Use Protected
Stream Segment - WBID	South Platte River Basin, Cache La Poudre Sub-basin, Stream Segment 12: Mainstem of the Cache La Poudre River from a point immediately above the confluence with Boxelder Creek to the confluence with the South Platte River. - COSPCP12
Classifications	Aquatic Life Warm 2 Recreation 1a Agriculture
Designation	Use Protected

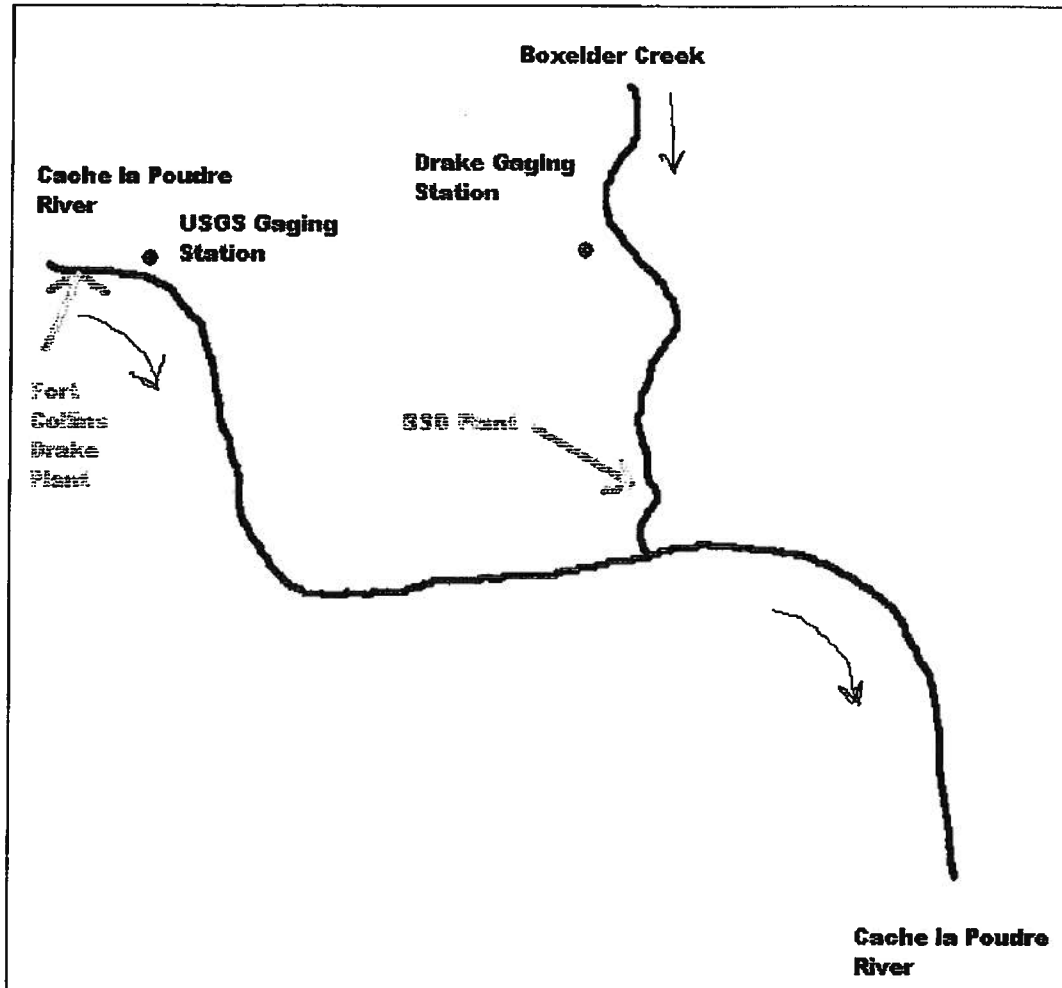
I. Introduction

The Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD) developed the water quality assessment (WQA) of Boxelder Creek and Cache la Poudre River near the Boxelder Sanitation District Wastewater Treatment Facility (WWTF). The WQA was prepared to facilitate reissuance of the Colorado Discharge Permit System (CDPS) permit for the Boxelder Sanitation District WWTF, CDPS Permit No. CO-0020478, and is intended to determine the assimilative capacities available to the Boxelder Sanitation District WWTF for pollutants of concern.

Figure 1 contains a map of the study area evaluated as part of this WQA.

The Boxelder Sanitation District WWTF discharges to Boxelder Creek 0.03 miles (170 ft.) above the confluence with the Cache La Poudre River. This segment of Boxelder Creek is a perennial urban stream that travels through the eastern side of the City of Ft. Collins. This segment (COSPCP13b) and those of the Poudre River immediately upstream (COSPCP11) and downstream (COSPCP12) of confluence with Boxelder Creek are on the State's 2006 303(d) List of Impaired Waters for high

concentrations of dissolved selenium. The hydraulic design capacity of this WWTF is 2.34 million gallons per day (MGD).



Information used in this assessment includes data from the Boxelder Sanitation District WWTF, and the U.S. Geological Survey (USGS). The data used in the assessment consist of the best information available at the time of preparation of this WQA.

II. Water Quality

The Boxelder Sanitation District WWTF discharges to Water Body Identification (WBID) stream segment COSPCP13b, which is the South Platte River Basin, Cache La Poudre River Sub-basin, Stream Segment 13b. This segment is composed of the “Mainstem of Boxelder Creek from its source to the confluence with the Cache La Poudre River.” Stream segment COSPCP13b is classified for:

- Aquatic Life Warm 2
- Recreation 1b (5/15 - 9/15)
- Recreation 2 (9/16 - 5/14)
- Agriculture

The Boxelder Sanitation District WWTF discharge will also affect the Water Body Identification (WBID) stream segment COSPCP12, which is the South Platte River Basin, Cache La Poudre River Sub-basin, Stream Segment 12. This segment is composed of the “Mainstem of the Cache La Poudre River from a point immediately above the confluence with Boxelder Creek to the confluence with the South Platte River.” Stream segment COSPCP12 is classified for:

- Aquatic Life Warm 2
- Recreation 1a
- Agriculture

Statewide Basic Standards have been developed in Section 31.11(2) and (3) of *The Basic Standards and Methodologies for Surface Water* to protect the waters of the state from radionuclides and organic chemicals. In Section 31.11(1) of the regulations, narrative standards are applied to any pollutant of concern, even where there is no numeric standard for that pollutant. Waters of the state shall be “free from harmful substances in harmful amounts.” Total dissolved solids (TDS), and sediment are such pollutants of concern being discussed by Agricultural and Water Quality Standards workgroups. In order to protect the Basic Standards in waters of the state, effluent limitations with monitoring, or “monitoring only” requirements for radionuclides, organics, TDS, or any parameter of concern could be put in CDPS discharge permits.

Numeric standards are developed on a basin-specific basis and are adopted for stream segments by the Water Quality Control Commission. To simplify the listing of the segment-specific standards, many of the aquatic life standards are contained in a table of each chapter of the regulations. The standards in Table 2a have been assigned to stream segment COSPCP13b, while the standards in Table 2b have been assigned to stream segment COSPCP12 in accordance with the *Classifications and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin*.

Table 2a
In-stream Standards for Stream Segment COSPCP13b

<i>Physical and Biological</i>
Dissolved Oxygen (DO) = 5 mg/l, minimum
pH = 6.5 - 9 su
Fecal Coliform = 2,000 colonies/100 ml (9/16 - 5/14)
<i>Escherichia coli</i> = 630 colonies/100 ml (9/16 - 5/14)
Fecal Coliform = 325 colonies/100 ml (5/15 - 9/15)
<i>Escherichia coli</i> = 205 colonies/100 ml (5/15 - 9/15)
<i>Inorganic</i>
NH ₃ (ac/ch) = TVS, Temp. Mod. NH ₃ (ac/ch) = TVS(old) Exp. Date 12/31/2011
Chlorine acute = 0.019 mg/l
Chlorine chronic = 0.011 mg/l
Free Cyanide = 0.005 mg/l
Sulfide chronic = 0.002 mg/l
Boron chronic = 0.75 mg/l
Nitrite = 0.5 mg/l
<i>Metals</i>
Total Recoverable Arsenic chronic = 100 ug/l
Dissolved Cadmium acute and chronic = TVS
Dissolved Trivalent Chromium acute and chronic = TVS
Dissolved Hexavalent Chromium acute and chronic = TVS
Dissolved Copper acute and chronic = TVS,
Total Recoverable Iron chronic = 1,000 ug/l
Dissolved Lead acute and chronic = TVS
Dissolved Manganese acute and chronic = TVS
Total Mercury chronic = 0.01 ug/l
Dissolved Nickel acute and chronic = TVS
Dissolved Selenium acute and chronic = TVS
Dissolved Silver acute and chronic = TVS
Dissolved Zinc acute and chronic = TVS

Table 2b
In-stream Standards for Stream Segment COSPCP12

<i>Physical and Biological</i>
Dissolved Oxygen (DO) = 5 mg/l, minimum
pH = 6.5 - 9 su
Fecal Coliform = 200 colonies/100 ml
<i>E. coli</i> = 126 colonies/100 ml, Temp. Mod. <i>E. coli</i> = 146/100ml bel. Eaton Draw in Greeley
<i>Inorganic</i>
NH ₃ (ac/ch) = TVS, Temp. Mod. NH ₃ (ac/ch) = TVS(old) Exp. Date 12/31/2011
Chlorine acute = 0.019 mg/l
Chlorine chronic = 0.011 mg/l
Free Cyanide = 0.005 mg/l
Sulfide chronic = 0.002 mg/l
Boron chronic = 0.75 mg/l
Nitrite = 2.7 mg/l (as 30-day Average)
<i>Metals</i>
Total Recoverable Arsenic chronic = 100 µg/l
Dissolved Cadmium acute and chronic = TVS
Dissolved Trivalent Chromium acute and chronic = TVS
Dissolved Hexavalent Chromium acute and chronic = TVS
Cu acute and chronic = TVS, Temp. Mod. Cu(ac/ch) = Current Condition Exp. Date 12/09/2009
Total Recoverable Iron chronic = 1,000 µg/l
Dissolved Lead acute and chronic = TVS
Dissolved Manganese acute and chronic = TVS
Total Mercury chronic = 0.01 µg/l
Dissolved Nickel acute and chronic = TVS
Dissolved Selenium acute and chronic = TVS
Dissolved Selenium chronic = TVS
Dissolved Silver acute and chronic = TVS
Dissolved Zinc acute and chronic = TVS

Standards for metals are generally shown in the regulations as Table Value Standards (TVS), and these often must be derived from equations that depend on the receiving stream hardness or species of fish present. The Classification and Numeric Standards documents for each basin include a specification for appropriate hardness values to be used.

The mean hardness was computed to be 585 mg/l as CaCO₃ based on sampling data from the Cache La Poudre River above Boxelder Creek. A regression of the hardness to the flow also indicates the hardness > 400 mg/l at low-flow conditions. Since this hardness is reflective of the base flow (low flow) groundwater conditions, the hardness was found to be similarly high in Boxelder Creek. However, since the maximum hardness that can be used in TVS equations is capped at 400 mg/l as CaCO₃, a hardness of 400 mg/l as CaCO₃ was used in the calculations of the TVS levels. This hardness value and the formulas contained in the TVS were used to calculate the in-stream water quality standards for metals, with the results shown in Table 3.

Table 3
TVS-Based Metals Water Quality Standards For CO-0020478
 Based on the Table Value Standards Contained in the Colorado Department of Public Health
 and Environment Water Quality Control Commission *Regulation 38*

Calculated Using the Following Value for
 Hardness as CaCO₃:

400 mg/l

Parameter	In-Stream Water Quality Standard			Formula Used
	Acute	Chronic	Standard	
Cadmium, Diss*	Acute	19.1	µg/l	$[1.13667-0.04184\ln(\text{hardness})]e^{(1.128(\ln(\text{hardness}))-3.6867)}$
	Chronic	6.22	µg/l	$[1.10167-0.04184\ln(\text{hardness})]e^{(0.7852(\ln(\text{hardness}))-2.715)}$
Chromium III, Diss	Acute	1,773	µg/l	$e^{(0.819(\ln(\text{hardness}))+2.5736)}$
	Chronic	231	µg/l	$e^{(0.819(\ln(\text{hardness}))+0.5340)}$
Chromium VI, Diss	Acute	16	µg/l	Numeric standards provided, formula not applicable
	Chronic	11	µg/l	Numeric standards provided, formula not applicable
Copper, Diss	Acute	49.6	µg/l	$e^{(0.9422(\ln(\text{hardness}))-1.7408)}$
	Chronic	29.3	µg/l	$e^{(0.8545(\ln(\text{hardness}))-1.7428)}$
Lead, Diss	Acute	281	µg/l	$[1.46203-0.145712\ln(\text{hardness})]e^{(1.273(\ln(\text{hardness}))-1.46)}$
	Chronic	10.9	µg/l	$[1.46203-0.145712\ln(\text{hardness})]e^{(1.273(\ln(\text{hardness}))-4.705)}$
Manganese, Diss	Acute	4,738	µg/l	$e^{(0.3331(\ln(\text{hardness}))+6.4676)}$
	Chronic	2,618	µg/l	$e^{(0.3331(\ln(\text{hardness}))+5.8743)}$
Nickel, Diss	Acute	1,513	µg/l	$e^{(0.846(\ln(\text{hardness}))+2.253)}$
	Chronic	168	µg/l	$e^{(0.846(\ln(\text{hardness}))+0.0554)}$
Selenium, Diss	Acute	18.4	µg/l	Numeric standards provided, formula not applicable
	Chronic	4.6	µg/l	Numeric standards provided, formula not applicable
Silver, Diss	Acute	22	µg/l	$\frac{1}{2} e^{(1.72(\ln(\text{hardness}))-6.52)}$
	Chronic	3.47	µg/l	$e^{(1.72(\ln(\text{hardness}))-9.06)}$
Uranium, Diss	Acute	11,070	µg/l	$e^{(1.1021(\ln(\text{hardness}))+2.7088)}$
	Chronic	6,914	µg/l	$e^{(1.1021(\ln(\text{hardness}))+2.2382)}$
Zinc, Diss*	Acute	379	µg/l	$e^{(0.8473(\ln(\text{hardness}))+0.8618)}$
	Chronic	379	µg/l	$e^{(0.8473(\ln(\text{hardness}))+0.8699)}$

* - Both the Cd and Zn TVS equations will probably change during the next Reg. 38 RMH, and the effluent limitations calculated using these equations may need to be adjusted at that time.

Ambient Water Quality

The WQCD evaluates ambient water quality based on a variety of statistical methods as prescribed in Section 31.8(2)(a)(i) and 31.8(2)(b)(i)(B) of the *Colorado Department of Public Health and Environment Water Quality Control Commission Regulation No. 31*. Ambient water quality is evaluated in this WQA for use in determining assimilative capacities. To conduct an assessment of the ambient water quality in Boxelder Ck. upstream of the Boxelder Sanitation District WWTF, data collected by the Boxelder W&SD WWTF from Boxelder Creek that were analyzed. The data was collected above the Boxelder WWTF outfall. Data were available for a period of record from March 2001 through January 2007. A summary of the data is presented in Table 4a.

<i>Parameter</i>	<i>No. of Samples</i>	<i>15th Percentile</i>	<i>50th Percentile</i>	<i>85th Percentile</i>	<i>Mean</i>	<i>Chronic Stream Standard</i>	<i>Notes</i>
<i>E. coli, (#/100 ml)</i>	78	NA	NA	NA	25	630 (Sep.-May) 205 (May-Sep.)	1
<i>Hardness (mg/l CaCO₃)</i>	NA	NA	NA	NA	519	NA	
<i>As, Trec (µg/l)</i>	29	NA	0	NA	NA	100	2
<i>Cd, Dis (µg/l)</i>	29	NA	NA	0	NA	6.22	2
<i>Cr, Trec (µg/l)</i>	29	NA	0	NA	NA	NA	2
<i>Cu, Dis (µg/l)</i>	29	NA	NA	0	NA	29.3	2
<i>CN, Free (µg/l)</i>	NA	NA	NA	0	NA	NA	4
<i>Fe, Trec (µg/l)</i>	29	NA	140	NA	NA	1,000	
<i>Pb, Dis (µg/l)</i>	29	NA	NA	0	NA	10.9	2
<i>Mn, Dis (µg/l)</i>	29	NA	NA	27.8	NA	2,618	2
<i>Hg, Tot (µg/l)</i>	29	NA	NA	0	NA	0.010	3
<i>Ni, Dis (µg/l)</i>	29	NA	NA	1.12	NA	168	2
<i>Se, Dis (µg/l)</i>	29	NA	NA	16.7	NA	4.6	2
<i>Ag, Dis (µg/l)</i>	29	NA	NA	0	NA	3.47	2
<i>Zn, Dis (µg/l)</i>	29	NA	NA	5.29	NA	379	2
<p>Note 1: The calculated mean is the geometric mean. Note that for summarization purposes, the value of one was used where there was no detectable amount because the geometric mean of one is equal to zero. The limits are seasonal, 630/# per100 mL (9/16 – 5/14); 205 (5/15 – 9/15).</p> <p>Note 2: When sample results were below detection levels, the value of zero was used in accordance with the CO WQCD's standard approach for summarization and averaging purposes.</p> <p>Note 3: For the noted parameters, data were found at less than detection levels. The detection levels, however, were greater than the in-stream standards. In accordance with WQCD's procedures, no determination of water quality is made when the detection levels are greater than the in-stream standards.</p> <p>Note 4: For the noted parameters, because of lack of data these values were assumed zero for CN and TRC because of how rapidly these degrade in the environment, and for the case of E. coli and hardness the value is assumed the same as the other segment.</p>							

To conduct an assessment of the ambient water quality in the Cache La Poudre River upstream of the Boxelder Ck, data collected by the USGS at USGS Station 06752280, Cache La Poudre River near Timnath were analyzed. The data were collected at the gage above Boxelder Ck. Data were

available for a period of record from March 2000 through January 2005. A summary of the data is presented in Table 4b.

<i>Parameter</i>	<i>No. of Samples</i>	<i>15th Percentile</i>	<i>50th Percentile</i>	<i>85th Percentile</i>	<i>Mean</i>	<i>Chronic Stream Standard</i>	<i>Notes</i>
<i>E. coli</i> (#/100 ml)	NA	NA	NA	NA	25	126	1
Hardness (mg/l CaCO ₃)	301	NA	NA	NA	519	NA	
As, Trec (µg/l)	29	NA	1	NA	NA	100	2
Cd, Dis (µg/l)	12	NA	NA	0.034	NA	6.22	2
Cr, Trec (µg/l)	10	NA	0	NA	NA	NA	2
Cu, Dis (µg/l)	29	NA	NA	4.36	NA	29.3	2
CN, Free (µg/l)	NA	NA	NA	0	NA	NA	4
Fe, Trec (µg/l)	62	NA	239	NA	NA	1,000	
Pb, Dis (µg/l)	12	NA	NA	0.054	NA	10.9	2
Mn, Dis (µg/l)	85	NA	NA	92	NA	2,818	2
Hg, Tot (µg/l)	29	NA	NA	0	NA	0.010	3
Ni, Dis (µg/l)	12	NA	NA	2.35	NA	168	2
Se, Dis (µg/l)	12	NA	NA	7.28	NA	4.6	2
Ag, Dis (µg/l)	69	NA	NA	0	NA	3.47	2
Zn, Dis (µg/l)	12	NA	NA	5.04	NA	379	2

Note 1: The calculated mean is the geometric mean. Note that for summarization purposes, the value of one was used where there was no detectable amount because the geometric mean of one is equal to zero.

Note 2: When sample results were below detection levels, the value of zero was used in accordance with the CO WQCD's standard approach for summarization and averaging purposes.

Note 3: For the noted parameters, data were found at less than detection levels. The detection levels, however, were greater than the in-stream standards. In accordance with WQCD's procedures, no determination of water quality is made when the detection levels are greater than the in-stream standards.

Note 4: For the noted parameters, because of lack of data these values were assumed zero for CN and TRC because of how rapidly these degrade in the environment, and for the case of *E. coli* and hardness the value is assumed the same as the other segment.

III. Water Quantity

The Colorado Regulations specify the use of low flow conditions when establishing water quality based effluent limitations, specifically the acute and chronic low flows. The acute low flow, referred to as 1E3, represents the one-day low flow recurring in a three-year interval. The chronic low flow, 30E3, represents the 30-day average low flow recurring in a three-year interval.

Low Flow Analysis

To determine the low flows in Boxelder Creek available to the Boxelder Sanitation District WWTF a lengthy daily flow record just above the outfall would be best to use. There is no continuous flow record just above the Boxelder WWTF outfall. However, there have been over 850 flow measurements made in the creek just above the outfall since 1996. Low flow base flow conditions

have been recorded for all months in this 10 year period. This flow data was used to estimate the 1E3 and 30E3 low flows that occur above the outfall at a 1-in-3 year recurrence interval. This flow record and time frames were deemed the most accurate and representative of current flows and were therefore used in this analysis.

Based on the low flow analysis described previously, the upstream low flows available to the Boxelder Sanitation District WWTF were calculated and are presented in Table 5a.

Table 5a
Low Flows for Boxelder Creek upstream of the Boxelder Sanitation District WWTF

<i>Low Flow (cfs)</i>	<i>Annual</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>Jun</i>	<i>Jul</i>	<i>Aug</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>
1E3 Acute	2.3	3.1	3.3	3.6	3.3	3.3	2.9	3.3	2.9	2.3	2.7	3.2	3.2
30E3 Chronic	3.4	4.2	5.0	4.5	4.7	4.7	6.0	5.1	4.1	3.4	4.2	4.5	4.5

4.5

To determine the low flows in the Cache La Poudre River available just downstream of Boxelder Creek the USGS Gage 06752280, Cache La Poudre River above Boxelder Creek, near Timnath, seepage characteristics of the Poudre, and characteristic flows from Boxelder Creek were used in calculations of the low flow in the Cache La Poudre River just below the confluence with Boxelder Creek. A flow record from 1996 to 2006 was used. These low flows are shown below in Table 5b.

To maintain consistency the low flows from both tables 5a and 5b were used to calculate the difference what the low flow contributions from the Cache La Poudre would be above the confluence with Boxelder Creek.

Table 5b
Low Flows for the Poudre River just below Boxelder Creek Without the Boxelder or Drake WWTFs discharging. Used to Correlate low flows

<i>Low Flow (cfs)</i>	<i>Annual</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>Jun</i>	<i>Jul</i>	<i>Aug</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>
1E3 Acute	5.4	6.1	6.6	7	6.3	6.7	13	17	6.1	7.3	8.1	5.9	5.4
30E3 Chronic	6.1	6.7	7	7	7.4	9	19	20	17	14	6.9	6.1	6.1

4.5

IV. Technical Analysis

In-stream background data and low flows evaluated in Sections II and III are ultimately used to determine the assimilative capacity of Boxelder Creek or the Cache la Poudre River near the Boxelder Sanitation District WWTF for pollutants of concern, depending on whether the WWTF discharges to Boxelder Creek or Poudre River respectively. For all parameters except ammonia, it is the WQCD's approach to conduct a technical analysis of stream assimilation capacity using the lowest of the monthly low flows (referred to as the annual low flow) as calculated in the low flow analysis. For ammonia, it is the standard procedure of the WQCD to determine assimilative capacities for each month using the monthly low flows calculated in the low flow analysis, as the regulations allow the use of seasonal flows when establishing assimilative capacities. For seasonally changing limits (such as *E. coli* in Boxelder Creek), it is appropriate to compute the limits based on lowest flows within the season of interest.

The WQCD's standard analysis consists of steady-state, mass-balance calculations for most pollutants and modeling for pollutants such as ammonia. The mass-balance equation is used by the WQCD to calculate the maximum allowable concentration of pollutants in the effluent, and accounts for the upstream concentration of a pollutant at the existing quality, critical low flow (minimal dilution), effluent flow and the water quality standard. The mass-balance equation is expressed as:

Equation 1

$$M_2 = \frac{M_3Q_3 - M_1Q_1}{Q_2}$$

Where,

- Q_1 = Upstream low flow (1E3 or 30E3)
- Q_2 = Average daily effluent flow (design capacity)
- Q_3 = Downstream flow ($Q_1 + Q_2$)
- M_1 = In-stream background pollutant concentrations at the existing quality
- M_2 = Calculated maximum allowable effluent pollutant concentration
- M_3 = Maximum allowable in-stream pollutant concentration (water quality standards)

For this WQA three different types of scenarios must be examined. The first is to protect stream standards in Boxelder Creek, for which the allowable effluent limits are computed using the Equation 1. The second is to protect stream standards in the Cache La Poudre River when the Drake WWTF is not discharging to the Poudre River, for which the allowable effluent limits are computed using Equation 2;

Equation 2

$$M_2 = \frac{M_3 Q_3 - M_{1A} Q_{1A} - M_{1B} Q_{1B}}{Q_2}$$

Where,

Q_{1A} = Upstream low flow of stream A(1E3 or 30E3)

Q_{1B} = Upstream low flow of stream B(1E3 or 30E3)

Q_2 = Average daily effluent flow (design capacity)

Q_3 = Downstream flow ($Q_{1A} + Q_{1B} + Q_2$)

M_{1A} = In-stream background pollutant concentrations at the existing quality for stream A

M_{1B} = In-stream background pollutant concentrations at the existing quality for stream B

M_2 = Calculated maximum allowable effluent pollutant concentration

M_3 = Maximum allowable in-stream pollutant concentration (water quality standards)

The third is to protect stream standards in the Cache La Poudre River when the Drake WWTF is discharging to the Poudre River for which the allowable effluent limits are computed using the Equation 3:

Equation 3

$$M_2 = \frac{M_3 Q_3 - M_{1A} Q_{1A} - M_{1B} Q_{1B} - M_{1C} Q_{1C}}{Q_2}$$

Where,

Q_{1A} = Upstream low flow of stream A(1E3 or 30E3)

Q_{1B} = Upstream low flow of stream B(1E3 or 30E3)

Q_{1C} = Design flow of facility discharging into stream B at an upstream location

Q_2 = Average daily effluent flow (design capacity)

Q_3 = Downstream flow ($Q_{1A} + Q_{1B} + Q_{1C} + Q_2$)

M_{1A} = In-stream background pollutant concentrations at the existing quality for stream A

M_{1B} = In-stream background pollutant concentrations at the existing quality for stream B

M_{1C} = Maximum allowable in-stream pollutant concentration (water quality standards) for stream B in the upstream location

M_2 = Calculated maximum allowable effluent pollutant concentration

M_3 = Maximum allowable in-stream pollutant concentration (water quality standards) for combined stream at a downstream location

Tables for all of these situations are shown in this WQA, including the seasonal limits for pathogens. It is possible to calculate monthly effluent limitations for all parameters (besides ammonia), however the vast majority of these types of limits would never be implemented. To reduce the amount of tables to a reasonable level in this WQA no monthly limits will be calculated at this time for parameters other than ammonia. If in the future one of these other parameters becomes more of a concern, it is possible that monthly limits could be calculated.

Pollutants Evaluated

The following parameters were identified by the WQCD as pollutants to be evaluated for this facility:

- Ammonia
- *E. coli*
- Total Residual Chlorine
- Temperature
- Metals & Cyanide

It is WQCD's standard procedure to consider metals and cyanide as potential pollutants of concern for all major POTWs.

Boxelder Sanitation District WWTF

The Boxelder Sanitation District WWTF is located in southeast Ft. Collins in Larimer County. The current design capacity of the facility is 2.34 MGD. Wastewater treatment is accomplished using a aerated lagoon wastewater treatment process. The technical analyses that follow include assessments of the assimilative capacity based on this design capacity.

Nearby Sources

The ambient water quality background concentrations used in the mass-balance equation account for pollutants of concern contributed by upstream sources, and thus it was not necessary to model upstream dischargers together with the Boxelder Sanitation District WWTF when determining the available assimilative capacities in Boxelder Creek. However, the following point source discharges to Boxelder Creek were identified above the Boxelder WWTF.

- Town of Wellington WWTF (CO-0046451)

Also, the following point source discharges to the Cache la Poudre River were identified just above and downstream of the confluence of Boxelder Creek and the Poudre River:

- City of Ft. Collins Mulberry WRF and Drake WRF (CO-0026425)
- City of Greeley WPCF (CO-0040258)
- Eastman Kodak Company (CO-0032158)
- Town of Windsor WWTF (CO-0020320)

Based on the distances and changes in flow from diversions and additions, only the Drake WRF might have an influence on the Boxelder WWTF. However, it works out that for ammonia standards computation, the critical point for the Boxelder WWTF is sometimes in Boxelder Creek and other times in the Cache La Poudre River, so there is a need to model the Drake WWTF with the Boxelder WWTF. However, the Drake WRF has not discharged to the mainstem Cache La Poudre River in the last 10 years, so there is a question of the need of the Drake WWTF discharge to the Cache La Poudre River. Furthermore, there are water rights requirements that necessitate the Drake WRF having to continue its discharge to the Fossil Creek Reservoir Inlet Ditch. If any limitations for the for Boxelder WWTF become too restrictive because of assumptions made about the Drake WWTF discharge, it is probable that further Waste Load Allocation discussions with the Drake WWTF

would need to take place. Based on limited information of non-point sources, and the complexity of the watershed contributions to Boxelder Creek, these specific non-point sources were not considered in this assessment. However, upstream loading above the Boxelder WWTF, and the Cache La Poudre River were used in calculations.

Water Supply

There are no current surface water diversions for a public water supply from this segment. However, there are alluvial wells along this segment, used primarily for irrigation.

Chlorine

The mass-balance equation was used to determine the assimilative capacity for chlorine. Because chlorine is rapidly oxidized, in-stream levels of residual chlorine are detected only for a short distance below a source. Ambient chlorine was therefore assumed to be zero. However, there is one point source discharging chlorine within two miles of the Boxelder Sanitation District WWTF and this is included in the appropriate scenario (w/ Drake discharging in Table 6c).

Using the mass-balance equation provided in the beginning of Section IV, the acute and chronic low flows set out in Section III, the chlorine background concentration of zero as discussed above, and the in-stream standards for chlorine shown in Section II, assimilative capacities for chlorine were calculated. The data used and the resulting calculations of the allowable discharge concentration, M_2 , are set forth below in Tables 6a, 6b, and 6c.

<i>Parameter</i>	Q_1 (cfs)	Q_2 (cfs)	Q_3 (cfs)	M_1 (mg/l)	M_3 (mg/l)	M_2 (mg/l)
TRC (ac)	2.3	3.63	5.93	0	0.019	0.031
TRC (ch)	3.4	3.63	7.03	0	0.011	0.021

<i>Parameter</i>	Q_{Poudre} (cfs)	M_{Poudre} (mg/l)	Q_{Bak} (cfs)	M_{Bak} (mg/l)	Q_{WWTF} (cfs)	Q_{Tot} (cfs)	M_3 (mg/l)	M_2 (mg/l)
TRC (ac)	2.7	0	2.3	0	3.63	8.63	0.019	0.045
TRC (ch)	2.7	0	3.4	0	3.63	9.73	0.011	0.029

*-This value would be 3.1 cfs based on $5.4 - 2.3$, however this makes the $ch < ac$ so this low flow was set to 2.7.

	Q_{Drake} (cfs)	M_{Drake} (mg/l)	Q_{Bak} (cfs)	M_{Bak} (mg/l)	Q_{WWTF} (cfs)	Q_{Tot} (cfs)	M_3 (mg/l)	M_2 (mg/l)
TRC (ac)	35.58	0.019	5.4	0	3.63	44.61	0.019	0.047
TRC (ch)	35.58	0.011	6.1	0	3.63	45.31	0.011	0.029

Temperature

The mass-balance equation was used to determine the assimilative capacity, or Maximum Weekly Effluent Temperature (MWET) for temperature. The upstream Maximum Weekly Average Temperature (MWAT) for Boxelder Ck. was determined from limited data supplied by the Boxelder WWTF. All seven-day averages had at least 2 days in the averaging period. It was possible to generate 81 representative seven-day averages from the data. The MWAT of this data is 17.2 degrees C. The upstream MWAT for the Cache La Poudre River was determined from the limited available data that was collected at USGS Gage 06752800. Data were spaced too widely apart to establish a standard MWAT so the highest 3-month summertime average (23.6 degrees C) was used. There was not enough data from Boxelder Creek to reliably generate a 7E3 for calculations, so the annual 30E3 low flow was used as the low flow statistic until further data is gathered to refine the 7E3 low flow value.

Using the mass-balance equation provided in the beginning of Section IV, the chronic low flows set out in Section III, the MWAT as discussed above, and the in-stream standards for temperature shown in Section II, assimilative capacity for temperature was calculated. The data used and the resulting calculations of the allowable MWET, M_2 , are set forth below in Table 7a, 7b, and 7c.

<i>Parameter</i>	<i>Q₁ (cfs)</i>	<i>Q₂ (cfs)</i>	<i>Q₃ (cfs)</i>	<i>MWAT</i>	<i>Standard</i>	<i>MWET</i>
Temp. C°	3.4	3.63	7.03	17.2	30	42

<i>Parameter</i>	<i>Q_{Poudre} (cfs)</i>	<i>M_{Poudre} C°</i>	<i>Q_{Box} (cfs)</i>	<i>M_{Box} C°</i>	<i>Q_{WWTF} (cfs)</i>	<i>Q_{Tot} (cfs)</i>	<i>M₃ C°</i>	<i>MWET</i>
Temp. C°	2.7	17.2	3.4	23.7	3.63	9.73	30	45

	<i>Q_{Drake} (cfs)</i>	<i>M_{Drake} C°</i>	<i>Q_{R&P} (cfs)</i>	<i>M_{R&P} C°</i>	<i>Q_{WWTF} (cfs)</i>	<i>Q_{Tot} (cfs)</i>	<i>M₃ C°</i>	<i>MWET</i>
Temp. C°	35.58	30	6.1	20.7	3.63	45.31	30	46

Escherichia coli

There is one point source discharging *E. coli* within two miles of the Boxelder Sanitation District WWTF and this is included in the appropriate scenario (w/ Drake discharging in Table 8c). It is the standard approach of the WQCD to perform a mass-balance calculation to determine if *E. coli* standards will be exceeded. WQCD procedure specifies that checks be conducted using only the chronic low flow as set out in Section III. Using the mass-balance equation provided in the beginning of Section IV, the background concentration contained in Section II, and the in-stream standards for fecal *E. coli* shown in Section II, calculations of the assimilative capacity for *E. coli* were conducted. There are seasonal pathogen indicator standards on this segment and calculations for both are shown below. The data used and the resulting calculations of the allowable discharge concentration, M_2 , are set forth below in Tables 8a, 8b, and 8c.

Parameter	Q_1 (cfs)	Q_2 (cfs)	Q_3 (cfs)	M_1 (#/100 ml)	M_3 (#/100 ml)	M_2 (#/100 ml)
<i>E. coli</i> (9/16-5/14)	4.1	3.63	7.83	25	630	1,313
<i>E. coli</i> (5/15-9/15)	3.4	3.63	7.03	25	205	374

	Q_{Poudre} (cfs)	M_{Poudre} (#/100 ml)	Q_{Drake} (cfs)	M_{Drake} (#/100 ml)	Q_{WWTF} (cfs)	Q_{Tot} (cfs)	M_3 (#/100 ml)	M_2 (#/100 ml)
<i>E. coli</i>	2.7	25	3.4	25	3.63	9.73	126	296

	Q_{Drake} (cfs)	M_{Drake} (#/100 ml)	Q_{Poudre} (cfs)	M_{Poudre} (#/100 ml)	Q_{WWTF} (cfs)	Q_{Tot} (cfs)	M_3 (#/100 ml)	M_2 (#/100 ml)
<i>E. coli</i>	35.58	126	6.1	25	3.63	45.31	126	296

Metals and Cyanide

Metals and cyanide may be present at large domestic WWTFs that accept discharges from industrial contributors. It is the standard approach of the WQCD to determine the available assimilative capacities for cyanide and those metals for which ambient water quality standards are available.

Using the mass-balance equations provided in the beginning of Section IV, the low flows provided in Section III, the background concentrations contained in Section II, and the in-stream standards for

metals shown in Section II, assimilative capacities were calculated. The data used and the resulting calculations of the allowable discharge concentrations, M_2 , are set forth in Table 8a for chronic WQBEL and 8b for acute WQBEL.

	Q1 (cfs)	Q2 (cfs)	Q3 (cfs)	M1	M3	M2
Ag (dis)	2.3	3.63	5.93	0	22.02	36
Cd (dis)	2.3	3.63	5.93	0	19.12	31
CrIII (dis)	2.3	3.63	5.93	0	1773.32	2,897
CrVI (dis)	2.3	3.63	5.93	0	16	26
Cu (dis)	2.3	3.63	5.93	0	49.62	81
Mn (dis)	2.3	3.63	5.93	28	4737.94	7,722
Ni (dis)	2.3	3.63	5.93	1.12	1512.89	2,471
Pb (dis)	2.3	3.63	5.93	0	280.85	459
Se (dis)	2.3	3.63	5.93	16.7	18.4	19.5
Zn (dis)	2.3	3.63	5.93	5.29	379.32	616
CN (free)	2.3	3.63	5.93	0	0.005	0.008

	Q1 (cfs)	Q2 (cfs)	Q3 (cfs)	M1	M3	M2
Ag (dis)	3.4	3.63	7.03	0	3.47	6.73
As (trec)	3.4	3.63	7.03	0	100	194
Cd (dis)	3.4	3.63	7.03	0	6.22	12
CrIII (dis)	3.4	3.63	7.03	0	230.67	447
CrVI (dis)	3.4	3.63	7.03	0	11	21.3
Cu (dis)	3.4	3.63	7.03	0	29.28	56.7
Fe (trec)	3.4	3.63	7.03	140	1,000	1,806
Hg (tot)	3.4	3.63	7.03	0	0.01	0.02
Mn (dis)	3.4	3.63	7.03	28	2617.71	5,043
Ni (dis)	3.4	3.63	7.03	1.12	168.04	324
Pb (dis)	3.4	3.63	7.03	0	10.94	21
Se (dis)*	3.4	3.63	7.03	16.7	4.6	4.6*
Zn	3.4	3.63	7.03	5.29	379.32	730

* - Effluent limits(M_2) set to ambient stream standards.

Table 9c
Acute WQBEL for Metals ($\mu\text{g/l}$) and Cyanide (mg/l)
In the Poudre w/o Drake WWTF Discharging

	$Q_{\text{Poudre}} \text{ (cfs)}$	M_{Poudre}	$Q_{\text{Box}} \text{ (cfs)}$	M_{Box}	$Q_{\text{WWTF}} \text{ (cfs)}$	$Q_{\text{Tot}} \text{ (cfs)}$	M_1	M_2
Ag (dis)	2.7	0	2.3	0	3.63	8.63	22.02	52
Cd (dis)	2.7	0.034	2.3	0	3.63	8.63	19.12	45
CrIII (dis)	2.7	0	2.3	0	3.63	8.63	1773.32	4,216
CrVI (dis)	2.7	0	2.3	0	3.63	8.63	16	38
Cu (dis)	2.7	4.36	2.3	0	3.63	8.63	49.62	115
Mn (dis)	2.7	92	2.3	28	3.63	8.63	4737.94	11,178
Ni (dis)	2.7	2.35	2.3	1.12	3.63	8.63	1512.89	3,594
Pb (dis)	2.7	0.054	2.3	0	3.63	8.63	280.85	668
Se (dis)	2.7	7.28	2.3	16.7	3.63	8.63	18.4	28
Zn (dis)	2.7	5.04	2.3	5.29	3.63	8.63	379.32	895
CN (free)	2.7	0	2.3	0	3.63	8.63	0.005	0.012

Table 9d
Chronic WQBELs for Metals ($\mu\text{g/l}$) and Cyanide (mg/l)
In the Poudre w/o Drake WWTF Discharging

	$Q_{\text{Poudre}} \text{ (cfs)}$	M_{Poudre}	$Q_{\text{Box}} \text{ (cfs)}$	M_{Box}	$Q_{\text{WWTF}} \text{ (cfs)}$	$Q_{\text{Tot}} \text{ (cfs)}$	M_1	M_2
Ag (dis)	2.7	0	3.4	0	3.63	9.73	3.5	9.3
As (trec)	2.7	1	3.4	0	3.63	9.73	100	267
Cd (dis)	2.7	0.034	3.4	0	3.63	9.73	6.22	16.7
CrIII (dis)	2.7	0	3.4	0	3.63	9.73	230.67	618
CrVI (dis)	2.7	0	3.4	0	3.63	9.73	11	29
Cu (dis)	2.7	4.36	3.4	0	3.63	9.73	29.28	75
Fe (trec)	2.7	239	3.4	140	3.63	9.73	1,000	2,372
Hg (tot)	2.7	0	3.4	0	3.63	9.73	0.01	0.027
Mn (dis)	2.7	92	3.4	28	3.63	9.73	2617.71	6,922
Ni (dis)	2.7	2.35	3.4	1.12	3.63	9.73	168.04	448
Pb (dis)	2.7	0.054	3.4	0	3.63	9.73	10.94	29
Se (dis)*	2.7	7.28	3.4	16.7	3.63	9.73	4.6	4.6*
Zn (dis)	2.7	5.04	3.4	5.29	3.63	9.73	379.32	1,008

* - Effluent limits (M_2) set to ambient stream standards.

	Q_{Drake} (cfs)	M_{Drake}	Q_{BAR} (cfs)	M_{BAR}	Q_{WWTF} (cfs)	Q_{TRN} (cfs)	M_1	M_2
Ag (dis)	35.58	3.47	5.4	0.00	3.63	44.61	22.02	237
Cd (dis)	35.58	6.22	5.4	0.02	3.63	44.61	19.12	174
CrIII (dis)	35.58	230.67	5.4	0.00	3.63	44.61	1773.32	19,532
CrVI (dis)	35.58	11.00	5.4	0.00	3.63	44.61	16	89
Cu (dis)	35.58	29.28	5.4	1.96	3.63	44.61	49.62	320
Mn (dis)	35.58	2617.71	5.4	52.13	3.63	44.61	4737.94	32,490
Ni (dis)	35.58	168.04	5.4	1.49	3.63	44.61	1512.89	16,943
Pb (dis)	35.58	10.94	5.4	0.02	3.63	44.61	280.85	3,344
Se (dis)	35.58	4.60	5.4	9.68	3.63	44.61	18.4	166
Zn (dis)	35.58	379.32	5.4	4.30	3.63	44.61	379.32	937
CN (free)	35.58	0.005	5.4	0.00	3.63	44.61	0.005	0.01

	Q_{Drake} (cfs)	M_{Drake}	Q_{BAR} (cfs)	M_{BAR}	Q_{WWTF} (cfs)	Q_{TRN} (cfs)	M_1	M_2
Ag (dis)	35.58	3.5	6.1	0.00	3.63	45.31	3.5	9.3
As (tree)	35.58	100.00	6.1	0.45	3.63	45.31	100	267
Cd (dis)	35.58	6.22	6.1	0.02	3.63	45.31	6.22	16.7
CrIII (dis)	35.58	230.67	6.1	0.00	3.63	45.31	230.67	618
CrVI (dis)	35.58	11.00	6.1	0.00	3.63	45.31	11	30
Cu (dis)	35.58	29.28	6.1	1.96	3.63	45.31	29.28	75
Fe (tree)	35.58	1000.00	6.1	186.88	3.63	45.31	1000	2,366
Hg (tot)	35.58	0.01	6.1	0.00	3.63	45.31	0.01	0.0
Mn (dis)	35.58	2617.71	6.1	57.27	3.63	45.31	2617.71	6,920
Ni (dis)	35.58	168.04	6.1	1.69	3.63	45.31	168.04	448
Pb (dis)	35.58	10.94	6.1	0.02	3.63	45.31	10.94	29
Se (dis)*	35.58	4.60	6.1	12.74	3.63	45.31	4.6	4.6*
Zn (dis)	35.58	379.32	6.1	5.27	3.63	45.31	379.32	1,008

* - Effluent limits(M_2) set to ambient stream standards.

Ammonia

Ammonia is present in the aqueous environment in both ionized and un-ionized forms. It is the un-ionized form which is toxic and which is addressed by water quality standards. The proportion of total ammonia present in un-ionized form in the receiving stream is a function of the combined upstream and effluent ammonia concentrations, and the pH and temperature of the effluent and receiving stream, combined.

The Colorado Ammonia Model (CAM) is a software program designed to project the downstream effects of ammonia and the ammonia assimilative capacities available to each discharger based on upstream water quality and effluent discharges.

The CAM may be calibrated for a number of variables in addition to the data discussed above. The values used for the other variables in the model are listed below:

- Stream velocity = $0.3Q^{0.4d}$
- Ammonia loss rate = 12.8/day
- pH amplitude was assumed to be medium
- default times for pH maximum, temperature maximum, and time of day of occurrence
- threshold percent un-ionized ammonia was taken as 5.4 percent
- pH rebound was set at the default value of 0.2 s.u. per mile
- temperature rebound was set at the default value of 0.7 degrees C per mile.

Extensive data were available for the CAM analyses, and were used for the development of upstream characteristics, effluent characteristics, seepage characteristics, and downstream setpoint conditions.

Four different scenarios were run in the CAM. The first was calculating what limits would need to be met to prevent ammonia toxicity in Boxelder Creek. The second was what limits would need to be met to prevent ammonia toxicity in the Cache La Poudre River when the Drake WWTF is not discharging to the Poudre. The third was what limits would need to be met to prevent ammonia toxicity in the Cache La Poudre River while the Drake WWTF is discharging to the Poudre (giving equal limits to both WWTF). The fourth was what limits would need to be met to prevent ammonia toxicity in the Cache La Poudre River while the Drake WWTF is discharging to the Poudre (allocating ammonia loading based on Ft. Collins WQA). The lowest of all of the ammonia numbers from these scenarios would be used as permit effluent limitations. The results of this ammonia analyses are presented in Table's 9a, 9b, 9c, and 9d respectively.

<i>Month</i>	<i>Chronic (mg/l)</i>	<i>Acute (mg/l)</i>
January	30*	30
February	31*	31
March	31	32
April	23	28
May	24	34
June	25	33
July	20	36
August	18	32
September	16	27
October	20	28
November	32	33
December	28*	28

* - Acute modeled value less than chronic so both effluent limits set to lowest (acute).

Table 10b		
WQBEL for Total Ammonia		
In the Poudre w/o Drake WWTF Discharging		
<i>Month</i>	<i>Chronic (mg/l)</i>	<i>Acute (mg/l)</i>
January	38*	38
February	40*	40
March	37	43
April	26	37
May	28	45
June	31	50
July	26	50
August	20	37
September	23	43
October	23	42
November	35	43
December	28*	28

* - Acute modeled value less than chronic so both effluent limits set to lowest (acute).

Table 10c		
WQBEL for Total Ammonia		
In the Poudre with Drake WWTF Discharging		
@ Equal Ammonia Limits		
<i>Month</i>	<i>Chronic (mg/l)</i>	<i>Acute (mg/l)</i>
January	24.1	26
February	17.0	19
March	16.0	22
April	14.8	21
May	10.2	18
June	8.9	18
July	11.0	21
August	13.8	23
September	13.6	21
October	14.4	21
November	19.3	22
December	16*	16

* - Acute modeled value less than chronic so both effluent limits set to lowest (acute).

<i>Month</i>	<i>Chronic (mg/l)</i>	<i>Acute (mg/l)</i>
January	31	45
February	27	29
March	28	36
April	21	35
May	35	45
June	38	45
July	34	45
August	32	45
September	19 (25)¹	45
October	14 (25)¹	40
November	25	31
December	26*	26

* - Acute modeled value less than chronic so both effluent limits set to lowest (acute)

1 - As a further example of what adjusting the WLA will do, the numbers in parenthesis show what will happen if the Ft. Collins Drake WWTF would accept a 12.5 mg/l ammonia limit.

Future Ammonia Considerations

On October 1, 2007 the underlying standards for ammonia on segments COSPCP12 and COSPCP13b became the new total ammonia criteria. A Temporary Modification for ammonia "old" is based on the old unionized ammonia standard until 12/31/2011. Effluent limitations for the old standard are established with CAM, while future effluent limits for ammonia were calculated using the latest AMMTOX ammonia model. Modeling with AMMTOX has been completed, and assuming similar modeling characteristics as those used in CAM shows that future effluent limits for the Boxelder WWTF will be considerably lower. These potential limits are shown in Tables A-11a and A-11b. The Boxelder WWTF has also completed modeling that shows the same results, in Report 228 by Dr. Bill Lewis in May of 2005.

	In Boxelder Ck.	In Poudre w/ Drake (assuming equal limits)	In Poudre w/o Drake
JAN	10	8.6	10
FEB	11	8.5	11
MAR	10	8.6	10
APR	5.9	7.6	5.9
MAY	7.0	7.3	7.0
JUN	10	8.1	10
JUL	7.5	7.2	7.5
AUG	7.4	13	7.4
SEP	6.7	14	6.7
OCT	7.7	11	7.7
NOV	8.6	15	8.6
DEC	10	14	10

	In Boxelder Ck.	In Poudre w/ Drake (assuming equal limits)	In Poudre w/o Drake
JAN	20	31	20
FEB	20	23	20
MAR	20	34	20
APR	39	41	39
MAY	21	47	21
JUN	30	51	30
JUL	27	50	27
AUG	28	42	28
SEP	21	43	21
OCT	17	40	17
NOV	15	42	15
DEC	19	30	19

V. Antidegradation Review

As set out in *The Basic Standards and Methodologies of Surface Water*, Section 31.8(2)(b), an antidegradation analysis is required except in cases where the receiving water is designated as "Use

Protected.” Note that “Use Protected” waters are waters “that the Commission has determined do not warrant the special protection provided by the outstanding waters designation or the antidegradation review process” as set out in Section 31.8(2)(b). The antidegradation section of the regulation became effective in December 2000, and therefore antidegradation considerations are applicable to this WQA.

According to the *Classifications and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin* stream segment COSPCP12 and COSPCP13b are Use Protected. Because the receiving waters are designated as Use Protected, no antidegradation review is necessary in accordance with the regulations. Thus, for purposes of this WQA, antidegradation review requirements have been met and no further antidegradation evaluation is necessary.

VI. References

Classifications and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin., Regulation No. 38, CDPHE, WQCC, Effective September 30, 2007.

Procedures for Conducting Assessments for Implementation of Temperature Standards in Discharge Permits, CDPHE, WQCD, Permits Section, 2007.

The Basic Standards and Methodologies for Surface Water, Regulation 31, CDPHE, WQCC, Effective July 1, 2007.

Antidegradation Significance Determination for New or Increased Water Quality Impacts, Procedural Guidance, CDPHE, WQCD, December 2001.