TST
CONSULTING ENGINEERS

GREATROCK NORTH WATER AND SANITATION DISTRICT
ENGINEER'S REPORT
June 23, 2014

Concentrate Disposal and Stream Reclassification

I spoke with Sarah Johnson, of the Division's Standards Unit, on June 3rd regarding the possibility of reclassification. Ms. Johnson directed me to two documents to be reviewed prior to initiating any stream reclassification efforts:

- The "Summary of the Rulemaking Process", and
- The "Public Participation Handbook"

The "Summary of the Rulemaking Process" is attached to this report, but the "Public Participation Handbook" is 29 pages – I will give a copy of it to Lisa.

I have also attached a copy of the Division's "denial of permit application for proposed discharge to surface water", as well as the Water Quality Assessment for Box Elder Creek near the District, for the Board members and staff to review. The denial is printed from a pdf file on the JR Engineering CDs.

At the June 16 Facilities Tour, Director Fleck presented a concept to enhance evaporation by lining the berm between the ponds and conveying concentrate across the liner and into the easterly end of the pond(s). Director Wyckoff developed a sketch of the concept and is working on pricing of the possible improvements.

Cla-Val Units at Pump Stations

Due to some emergency service requests in remote parts of Colorado and Wyoming, iSiWest, Inc. is now scheduled to perform the maintenance on July 14 and July 15. The service has been coordinated with Ramey Environmental Compliance.

Fire Hydrant Maintenance and Repairs

Lisa sent Action Fire Hydrant Service the Independent Contractor Agreement on June 23rd. Upon receipt of a fully-executed agreement and the necessary insurance certificate, the District will coordinate the work with the contractor. I have advised the Greater Brighton Fire Protection District of our plan and will provide Chief Krengel with a schedule and map once we are closer to performing the work.

Rocking Horse Farms Tank Repainting

The improvements were inspected and accepted on June 11, 2014. I have asked Jeff Rabas to schedule the 11-month warranty inspection in advance of June 11, 2015. On June 13th, I sent Lisa my recommendation for payment of Coblaco Services invoice for the work.

Relocation of Water Meters in Rocking Horse Farms

All but two of the curb stops have been located. Based upon the data collected by Jeff Rabas, I will compile and transmit my thoughts on the District's options in advance of the July Board meeting.

EDOP Compliance

Ramey Environmental Compliance has submitted the 2013 Annual Report to the Hazardous Materials and Waste Management Division. The next round of quarterly water quality sampling and analysis must be performed between July 1 and September 30.

Other Activities

Blending to Improve Water Quality: No additional sampling has been performed for reporting.

Utility Billings and Energy Costs: TST continues to track the United Power utility bills and associated water operations. Year-to-date information for usage and billings for the last three years is summarized below.

	2012	2013	2014
Usage (KWH)	172,346	162,536	124,249
Billing Amount	$22,158.96	$14,243.53	$10,395.33

The May 2014 energy usage for the Rocking Horse Farms Pump Station was unusually high. I will discuss this with Jeff Rabas and United Power in an effort to identify why.

Monthly Flow Reports: I occasionally monitor the daily SCADA reports for any anomalies, and will enhance the graphs to depict the daily water accounting through the first six months of 2014. Based upon a year-to-date review, the magnetic flow meter for the Greatrock North Pump Station appears to be out of calibration.

Rocking Horse Farms Pump Station: Ramey Environmental Compliance will schedule the 11-month warranty inspection before August of 2014.

Box Elder Creek Ranch Pump Station: Ramey Environmental Compliance will schedule the 11-month warranty inspection before March of 2015.

Greatrock North Pump Station: Options to reconfigure the pump station and type of pumping equipment is a 2015 budget discussion item.

Fire Pumps: This is a 2015 budget discussion item based upon information previously provided.

WATER QUALITY CONTROL COMMISSION
RULEMAKING HEARING PROCESS SUMMARY

I. Before the Hearing

A. Hearing Notice

A rulemaking process for the Water Quality Control Commission to formally consider new or revised water quality regulations is initiated by distribution of a Notice of Public Rulemaking Hearing. The notice provides information as to the date, time and place of the hearing, as well as information regarding the prehearing opportunities and requirements for those interested in participating in the rulemaking process. Generally, the proposed regulations or proposed revisions are attached to the hearing notice, along with a proposed Statement of Basis, Specific Statutory Authority and Purpose, which describes the proposed rationale for the changes that will be considered. Official publication of the notice is in the Colorado Register, although copies are also sent to persons that have expressed a specific interest in that rulemaking and all hearing notices are made available on the Commission's website. Typically, a hearing notice and proposal are approved by the Commission four months before the date of a hearing, and published/distributed approximately three months before the hearing.

B. Options for Participation

There are two options for participating in Commission rulemaking hearings: (1) those requesting "party status" must meet certain prehearing deadlines for the submission of documents and have the right to cross-examine witnesses at the hearing; and (2) any interested member of the public may provide written or oral comments without requesting party status.

C. Prehearing Procedures

The hearing notice establishes deadlines for the submission of prehearing statements (outlining parties' positions regarding the proposal) and rebuttal statements (responding to the other parties' positions) by parties. A prehearing conference is scheduled for about one month before the hearing, to resolve any procedural issues regarding the hearing, indentify unresolved substantive issues, and schedule time for parties' testimony at the hearing.

D. Written Comment

Deadlines are established in the hearing notice for written input from those with party status. Other members of the public may submit written comment any time up to and including the day of the hearing. However, the submission of written comments at least a week and a half before the hearing is strongly encouraged, so that the comments can be distributed to Commission members for review prior to the hearing. It is very difficult for Commission members to review materials received while the hearing is in process. Furthermore, for logistical reasons, the Commission office cannot guarantee that electronic submissions received after 1:00 p.m. the work day before the hearing will be provided to Commissioners for consideration. All hearing documents are available for review on the Commission's website.

II. At the Hearing

A. Testimony from Staff and Parties

Generally, the hearing will start with testimony from those requesting party status and from the Water Quality Control Division, which serves as staff to the Commission for rulemaking hearings. Typically, testimony is heard first from the proponent of the proposal, and then from others. Each entity has been allotted a specific amount of time as a result of discussions at the prehearing conference. Witnesses are sworn in and their testimony is heard, followed by questions from the Commission and any cross-examination.

B. Public Comment

Depending on the anticipated length of the hearing, sometimes a specific time is set to receive comments from members of the public who have not requested party status. Otherwise, public comment is generally heard at the conclusion of testimony from the parties and the Division staff. You may contact the Commission office prior to the hearing to find out what time has been scheduled. **If you wish to comment and have specific time constraints, notify the Commission Administrator, Trisha Oeth, or Program Assistant, Nancy Horan, so that appropriate arrangements can be made.** When a hearing is expected to be lengthy, a time limit (e.g., five minutes per person) may be established. Members of the public are sworn in and their testimony is heard. They may then be asked questions by Commission members or cross-examined by parties or the Division staff. Cross-examination of public commenters is rare.

C. Deliberations

After the Commission has heard all of the testimony from the parties, Division staff and the general public, and has received all written documents offered in a timely manner, the hearing record is closed. Generally, the Commission begins its deliberations immediately after the completion of a hearing, while the information is most fresh. Deliberations are open to the public. No new information can be introduced during deliberations, although the Commission will sometimes ask clarifying questions regarding information already in the record. Most commonly, the Commission's initial deliberations are concluded by giving "preliminary final approval" to any agreed upon changes, by vote of a majority of the Commission members present. This preliminary approval is subject to a final vote at a subsequent meeting. The Commission often will ask the staff to prepare appropriate revisions to the proposed regulations and the proposed Statement of Basis and Purpose, to reflect the changes given preliminary approval, which may vary from the initial proposal attached to the hearing notice after considering the information received. A set of "draft final action" documents is then typically circulated to the parties and other interested persons to review for accuracy prior to final action by the Commission.

D. Final Action

Final action is most commonly scheduled for the Commission's monthly meeting that follows the meeting at which the hearing is held. Any changes to the regulation are then officially published in the Colorado Register and posted on the Commission's website. Revisions usually become effective at the end of the month following final Commission approval, although some revisions have a delayed effective date to allow for EPA review.

For more information: See the Public Participation Handbook on the Commission's website or contact Commission Administrator, Trisha Oeth at 303-692-3468 or Program Assistant, Nancy Horan at 303-692-3463.

COLORADO DISCHARGE PERMIT SYSTEM (CDPS)

RATIONALE FOR PERMIT DENIAL

GREATROCK NORTH WATER AND SANITATION DISTRICT, BOX ELDER CREEK RANCH WATER
CDPS PERMIT NUMBER CO-047708, ADAMS COUNTY

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I. TYPE OF ACTION

Denial of Industrial Discharge Permit Application

II. FACILITY INFORMATION

A. Facility Type: Water Treatment Plant
Fee Category: Category 06, Subcategory 2

B. SIC Code: 4941 (Water Supply)

C. Legal Contact/Permittee: Troy L Whitmore
141 Union Blvd. Suite 150, Lakewood, CO 80228
(303) 987-0835

D. Facility Contact: Giles Free, Lead Project Engineer
(720) 872-9850

E. Facility Location: 16373 Rayburn Street, Hudson, CO 80642

F. Proposed Discharge location: Latitude 39 59 30" N, Longitude 104 30 07" W, Outfall 001A, following detention and prior to mixing with Box Elder Creek.

G. Facility Flows: 0.0504 MGD

III. RATIONALE FOR DENIAL

The water system at Box Elder Creek Ranch Water facility consists of three wells, a reverse osmosis treatment facility, a 500,000 gallon concrete water storage tank, and a pump station. The primary raw water source for this location is an alluvial well, Box Elder Creek Alluvium. The alluvial water is blended with groundwater from three Upper Arapahoe aquifer wells when demand exceeds the alluvial well capacity; it is then filtered using the reverse osmosis treatment. The reverse osmosis treatment process creates two distinct solutions; one is a clean permeate that is sent to a storage tank and used for drinking water, and the other is a concentrate of process wastewater. Currently this wastewater is sent to two lined evaporation ponds; however with an increase in service population there will be a need to discharge the effluent from the existing evaporation ponds into Box Elder Creek. The proposed discharge will take place after the reverse

osmosis treatment process discharges to the lined North Detention Pond where treatment of nitrates will be achieved through detention time. Detained water above the pond elevation of 5069 will pass through the lined South Detention Pond prior to discharging in a drainage channel that flows to Box Elder Creek.

Box Elder Creek, the receiving waterbody for the discharge, is classified for the following beneficial uses: Aquatic Life, Class 2 Warm; Recreation Class 2; and Agriculture. The receiving stream is designated as Use Protected and has a zero low flow. The maximum allowable effluent pollution concentrations determined in Appendix A of the water quality assessment represent the effluent limits that would be protective of water quality and those beneficial uses. These are also known as the water quality-based effluent limits (WQBELs).

There is no discharge occurring at the facility at this time and therefore monitoring data is limited. The proposed influent will primarily consist of alluvial well water from Box Elder Creek Alluvium. Influent source water data from Box Elder Creek Alluvium and effluent data from North and South Evaporation Ponds was submitted in the application process and compared to the appropriate WQBELs.

The reverse osmosis treatment process will result in an effluent with a concentrate that is three to four times greater than the concentrations present in the influent. This would raise the already elevated concentrations even further above those required to protect Box Elder Creek. No active treatment or plan to reduce metals is currently proposed at the Greatrock North Water and Sanitation Box Elder Creek Facility at this time. An evaluation of the influent monitoring results indicates that the facility will not be able to consistently meet the WQBELs for Selenium and possibly Iron and Sodium.

Table IV-1 – Comparison of Influent Monitoring Data to the WQBEL

Parameter	# Samples	Reported Average Concentration Daily Average	Reported Maximum Concentrations Avg/Min/ Max	Estimated Effluent Concentration (75% Recovery)	Acute/Chronic WQBEL
Selenium ug/l	2	4.45	4.45/3.2/5.7	13.4 – 17.8	18.4/4.6
Iron ug/l	1	540	540	1620 - 2160	NA/1000
Sodium mg/l	2	85.5	85.5/85/86	256.5 - 258	NA/96.6

The Division is precluded from issuing a new discharge permit if the permittee can not comply with any of the effluent limits which would be effective immediately. Therefore the Division is noticing its intent to deny the permit application submitted by Troy L. Whitmore on behalf of Greatrock North Water and Sanitation District. If there is additional technical information that supports the position that the proposed discharge can meet the effluent limits, then a new application should be submitted, along with this information, to the Division.

Maura McGovern
December 18, 2008

VIII. PUBLIC NOTICE COMMENTS

APPENDIX A
Water Quality Assessment
Box Elder Creek
Greatrock North Water and Sanitation District WWTF

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I. Water Quality Assessment Summary

Table A-1 includes summary information related to this WQA. This summary table includes key regulatory starting points used in development of the WQA such as: receiving stream information; threatened and endangered species; 303(d) and 305(b) listings; low flow and facility flow summaries; and a list of parameters evaluated.

Table A-1
WQA Summary

Facility Information			
Facility Name	**Permit Number**	**Design Flow (max 30-day ave, MGD)**	**Design Flow (max 30-day ave, CFS)**
F1. Box Elder Creek Ranch Water	CO-047708	0.0504	0.0779
Receiving Stream Information			

Receiving Stream Name	Segment ID	Designation	Classification(s)
S1.Box Elder Creek	COSPMS05a	Use Protected	Aquatic Life Warm 2, Recreation Class 2, Agriculture,

Low Flows (cfs)			
1E3 (1-day)	7E3 (7-day)	30E3 (30-day)	Ratio of 30E3 to the Design Flow (cfs)
S1. 0.00	0.00	0.00	F1: 0:1

Regulatory Information					
T&E Species	303(d) (Reg 93)	TMDL Status	305(b) (Reg 94)	Temporary Modification(s)	Control Regulation
No	None	None	None	None	None

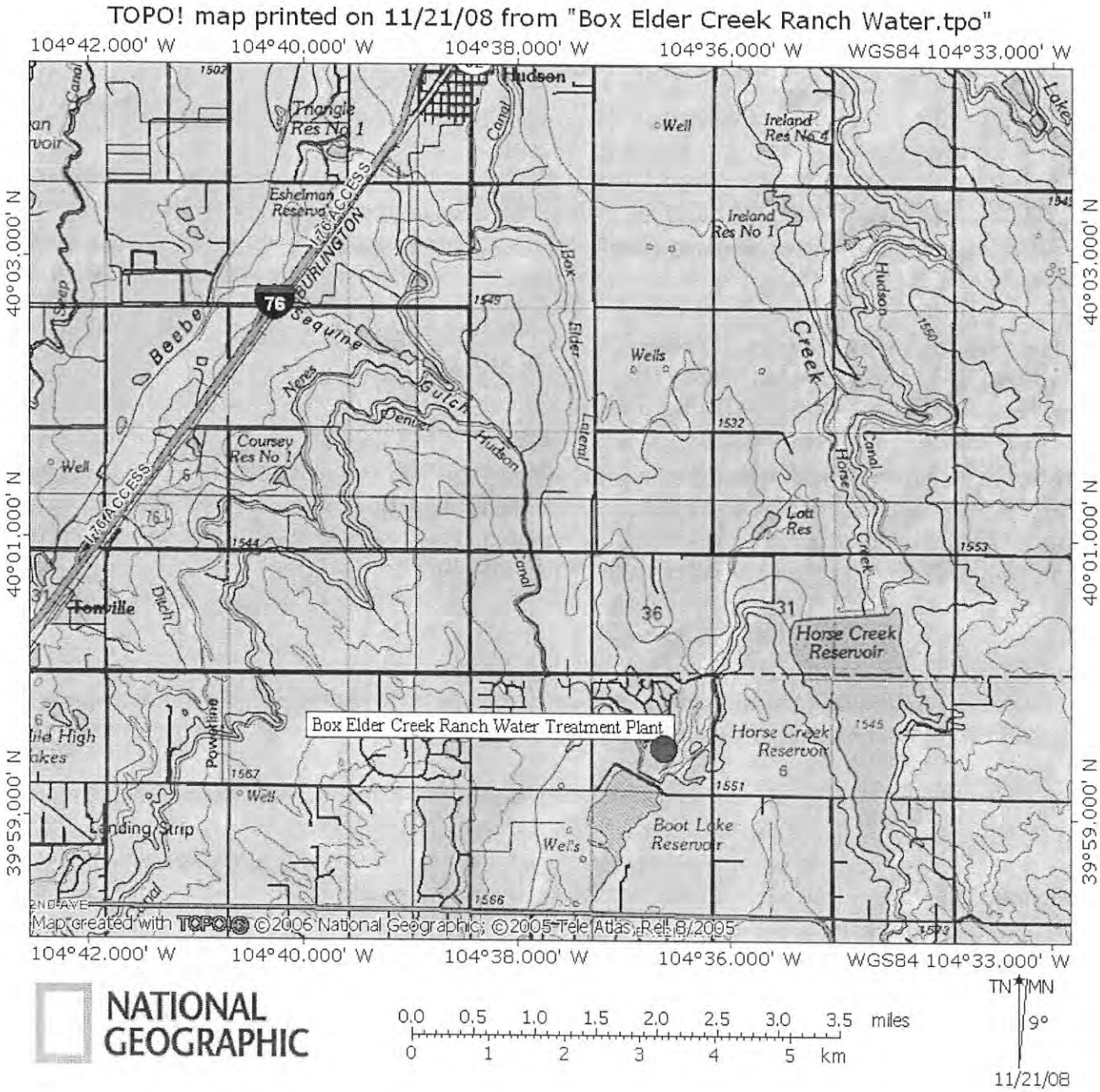
Pollutants Evaluated

- F1:Total Residual Chlorine, E. Coli, Fecal Coliform, Nitrite, Nitrate, Metals, Cyanide, Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR) and Adjusted SAR (SAR-adj).

II. Introduction

The water quality assessment (WQA) of Box Elder Creek near the Greatrock North Water and Sanitation District Wastewater Treatment Facility (WWTF), located in Adams County, is intended to determine the assimilative capacities available for pollutants found to be of concern. This WQA describes how the water quality based effluent limits (WQBELs) are developed. These parameters may or may not appear in the permit with limitations or monitoring requirements, subject to other determinations such as reasonable potential analysis, evaluation of federal effluent limitation guidelines, implementation of state-based technology based limits, mixing zone analyses, 303(d) listings, threatened and endangered species listing, or other requirements as discussed in the permit rationale. Figure A-1 contains a map of the study area evaluated as part of this WQA.

FIGURE A-1



The Greatrock North Water and Sanitation District WWTF discharges to Box Elder Creek, which is in the Water Body Identification (WBID) stream segment COSPMS05a. This means the South Platte River Basin, Middle South Platte Sub-basin, Stream Segment 05a. This segment is composed of the "Mainstream of Box Elder Creek from their sources to their confluences with the South Platte River."

Stream segment COSPMS05a is classified for Warm Water Aquatic Life Class 2, Class 2 Recreation and Agriculture. Greatrock North Water and Sanitation District provides potable water service to approximately 1400 year-round residents through 405 service taps. Currently the wastewater is sent to two lined evaporation ponds, however there is more development planned in the area that will increase the service population and the need for a new discharge from the existing evaporation ponds. This area of Colorado, other than these new single-family residential subdivisions, is predominantly agricultural.

Information used in this assessment includes data gathered from the Greatrock North Water and Sanitation District WWTF, the Division, the Colorado Division of Water Resources (DWR), and Riverwatch, The data used in the assessment consist of the best information available at the time of preparation of this WQA.

III. Water Quality Standards

Narrative Standards

Narrative Statewide Basic Standards have been developed in Section 31.11(1) of the regulations, and apply to any pollutant of concern, even where there is no numeric standard for that pollutant. Waters of the state shall be free from substances attributable to human-caused point source or nonpoint source discharges in amounts, concentrations or combinations which:

for all surface waters except wetlands;

(i) can settle to form bottom deposits detrimental to the beneficial uses. Depositions are stream bottom buildup of materials which include but are not limited to anaerobic sludges, mine slurry or tailings, silt, or mud; or
(ii) form floating debris, scum, or other surface materials sufficient to harm existing beneficial uses; or
(iii) produce color, odor, or other conditions in such a degree as to create a nuisance or harm existing beneficial uses or impart any undesirable taste to significant edible aquatic species or to the water; or
(iv) are harmful to the beneficial uses or toxic to humans, animals, plants, or aquatic life; or
(v) produce a predominance of undesirable aquatic life; or
(vi) cause a film on the surface or produce a deposit on shorelines; and

for surface waters in wetlands;

(i) produce color, odor, changes in pH, or other conditions in such a degree as to create a nuisance or harm water quality dependent functions or impart any undesirable taste to significant edible aquatic species of the wetland; or
(ii) are toxic to humans, animals, plants, or aquatic life of the wetland.

In order to protect the Basic Standards in waters of the state, effluent limitations and/or monitoring requirements for any parameter of concern could be put in CDPS discharge permits.

Standards for Organic Parameters and Radionuclides

Radionuclides: 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 no case shall radioactive materials in surface waters be increased by any cause attributable to municipal, industrial, or agricultural practices or discharges to as to exceed the following levels, unless alternative site-specific standards have been adopted. Standards for radionuclides are shown in Table A-2.

Table A-2
Radionuclide Standards

Parameter	Picocuries per Liter
Americium 241*	0.15
Cesium 134	80
Plutonium 239, and 240*	0.15
Radium 226 and 228*	5
Strontium 90*	8
Thorium 230 and 232*	60
Tritium	20,000

*Radionuclide samples for these materials should be analyzed using unfiltered (total) samples. These Human Health based standards are 30-day average values for both plutonium and americium.

Organics: The organic pollutant standards contained in the Basic Standards for Organic Chemicals Table are applicable to all surface waters of the state for the corresponding use classifications, unless alternative site-specific standards have been adopted. These standards have been adopted as "interim standards" and will remain in effect until alternative permanent standards are adopted by the Commission. These interim standards shall not be considered final or permanent standards subject to antibacksliding or downgrading restrictions. Although not reproduced in this WQA, the specific standards for organic chemicals can be found in Regulation 31.11(3).

In order to protect the Basic Standards in waters of the state, effluent limitations and/or monitoring requirements for radionuclides, organics, or any other parameter of concern could be put in CDPS discharge permits.

The aquatic life standards apply to all stream segments that are classified for aquatic life. The water supply standards apply only to those segments that are classified for water supply. The water + fish standards apply to those segments that have a Class 1 aquatic life and a water supply classification. The fish ingestion standards apply to Class 1 aquatic life segments that do not have a water supply designation. The water + fish and the fish ingestion standards may also apply to Class 2 aquatic life segments, where fish of a catchable size and which are normally consumed are present, and where fishing occurs on a regular basis.

Because the Box Elder Creek is classified for Class 2 aquatic life, without a water supply designation, the fish ingestion, and aquatic life standards apply to this discharge.

Salinity and Phosphorus

Phosphorus: Regulations 71, 72, 73 and 74, for Dillon Reservoir Watershed, Cherry Creek Reservoir Watershed, Chatfield Reservoir Watershed and the Bear Creek Watershed, contain requirements for phosphorus concentrations and phosphorus annual loadings for point source dischargers. If a facility discharges to one of these watersheds, a phosphorus allocation may be necessary, and limitations and annual loadings may be added to a permit.

Salinity: Regulation 61.8(2) (l) contains requirements regarding salinity for any discharges to the Colorado River Watershed. For industrial dischargers this is a no-salt discharge requirement. However, the regulation states that this requirement may be waived where the salt load reaching the mainstem of the Colorado River is less than 1 ton per day, or less than 366 tons per year. The Division may permit the discharge of salt upon a satisfactory demonstration that it is not practicable to prevent the discharge of all salt. See Regulation 61.8(2)(l)(i)(A)(1) for more information regarding this demonstration.

For municipal dischargers, an incremental increase of 400 mg/l above the flow weighted averaged salinity of the intake water supply is allowed. This may be waived where the salt load reaching the mainstem of the Colorado River is less than 1 ton per day, or less than 366 tons per year. The Division may permit the discharge of salt in excess of the 400 mg/l incremental increase, upon a satisfactory demonstration that it is not practicable to attain this limit. See Regulation 61.8(2)(l)(vi)(A)(1) for more information regarding this demonstration.

Regulation 75 contains requirements for the release of water from Cheraw Lake. Any entity releasing water from Cheraw Lake must ensure that either: 1) the water has a TDS concentration less than or equal to 4300 mg/l, or 2) that an adequate quantity of water of less saline nature can be supplied for dilution purposes such that a salinity level of 4300 ppm, measured as TDS, can be maintained in Horse Creek immediately above the first diversion below the confluence with the Cheraw Lake outlet channel.

In addition, the Division's policy, Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops, may be applied to discharges where an agricultural water intake exists downstream of a discharge point. Limitations for electrical conductivity, sodium absorption ratio, or sodium, may be applied in accordance with this policy.

Temperature

Temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no increase in temperature of a magnitude, rate, and duration deemed deleterious to the resident aquatic life. This standard shall not be interpreted or applied in a manner inconsistent with section 25-8-104, C.R.S. Effective until December 31, 2009: Segments or portions of segments that are first, second or third order streams above 7000 feet elevation and classified Aquatic Life cold 1 or 2 shall have a chronic temperature standard of 17 °C (MWAT) with no acute

standard. The following waters designated as Gold Medal fisheries by the Colorado Wildlife Commission shall have a chronic temperature standard of 18.2 °C (MWAT):

▪ South Platte River (rainbow and brown trout fishery, residual cutthroats)(A) From the confluence of the Middle and South Forks of the South Platte downstream to the inlet of Spinney Mountain Reservoir; (B) Middle fork from Highway 9 Bridge downstream to the South Fork of the South Platte; South fork above Antero Reservoir to Highway 285; (C)From the outlet of Spinney Mountain Reservoir downstream to the inlet of Elevenmile Canyon Reservoir; and

▪ Spinney Mountain Reservoir (rainbow and brown trout fishery, some Snake River cutthroat trout) on the South Platte River, 5 miles upstream of Elevenmile Canyon Reservoir.

Other cold class 1 or 2 segments or portions of segments shall have a chronic temperature standard of 20 °C (MWAT) with no acute standard. Segments that are classified Aquatic Life warm 1 or 2 shall have a chronic temperature standard of 30 °C (MWAT) with no acute standard.

Segment Specific Numeric Standards

Numeric standards are developed on a basin-specific basis and are adopted for particular 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 at the beginning of each chapter of the regulations. The standards in Table A-3 have been assigned to stream segment COSPMS05a in accordance with the *Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin.*

Table A-3 In-stream Standards for Stream Segment COSPMS05a
Physical and Biological
Dissolved Oxygen (DO) = 5 mg/l, minimum
pH = 6.5 - 9 su
Fecal Coliform chronic = 2000 colonies/100 ml
E. coli chronic = 630 colonies/100 ml
Inorganic
Total ammonia acute = TVS
Total ammonia chronic = TVS
Chlorine acute = 0.019 mg/l
Chlorine chronic = 0.011 mg/l
Free Cyanide acute = 0.005 mg/l
Sulfide chronic = 0.002 mg/l
Boron chronic = 0.75 mg/l
Nitrite acute = 0.5 mg/l
Metals and Cyanide
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
Dissolved Copper acute and chronic = TVS
Total Recoverable Iron chronic = 1000 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 Silver acute and chronic = TVS
Dissolved Zinc acute and chronic = TVS

Table Value Standards and Hardness Calculations

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; for ammonia, standards are discussed further in Section IV of this WQA. The Classification and Numeric Standards documents for each basin include a specification for appropriate hardness values to be used. Specifically, the regulations state that:

> The hardness values used in calculating the appropriate metal standard should be based on the lower 95% confidence limit of the mean hardness value at the periodic low flow criteria as determined from a regression analysis of site-specific data. Where insufficient site-specific data exists to define the mean hardness value at the periodic low flow criteria, representative regional data shall be used to perform the regression analysis. Where a regression analysis is not appropriate, a site-specific method should be used.

Hardness data for Box Elder Creek near the point of discharge of the Greatrock North Water and Sanitation District WWTF were insufficient to conduct a regression analysis based on the low flow. Therefore, the Division's alternative approach to calculating hardness was used, which involves computing a mean hardness.

The mean hardness of Box Elder Creek was computed to be 440 mg/l based on sampling data submitted by Greatrock North Water and Sanitation District. The *Basic Standards and Methodologies for Surface Water* indicates that hardness must be capped at 400 mg/l when determining in-stream metal water quality standards using the equations in the TVS. This maximum 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 A-4.

Table A-4

TVS-Based Metals Water Quality Standards for CO-047708

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 $CaCO_3$: 400 mg/l

Parameter	*In-Stream Water Quality Standard*		*Formula Used*
Cadmium, Dissolved	Acute	19.0 µg/l	$[1.13667-0.04184\ln(\text{hardness})][e^{(1.128(\ln(\text{hardness}))-3.6867)}]$
	Chronic	6.2 µg/l	$[1.10167-0.04184\ln(\text{hardness})][e^{(0.7852(\ln(\text{hardness}))-2.715)}]$
Trivalent Chromium, Dissolved	Acute	1773 µg/l	$e^{(0.819(\ln(\text{hardness}))+2.5736)}$
	Chronic	231 µg/l	$e^{(0.819(\ln(\text{hardness}))+0.5340)}$
Hexavalent Chromium, Dissolved	Acute	16 µg/l	Numeric standards provided, formula not applicable
	Chronic	11 µg/l	Numeric standards provided, formula not applicable
Copper, Dissolved	Acute	50 µg/l	$e^{(0.9422(\ln(\text{hardness}))-1.7408)}$
	Chronic	29 µg/l	$e^{(0.8545(\ln(\text{hardness}))-1.7428)}$
Lead, Dissolved	Acute	281 µg/l	$[1.46203-0.145712\ln(\text{hardness})][e^{(1.273(\ln(\text{hardness}))-1.46)}]$
	Chronic	11.0 µg/l	$[1.46203-0.145712\ln(\text{hardness})][e^{(1.273(\ln(\text{hardness}))-4.705)}]$
Manganese, Dissolved	Acute	4738 µg/l	$e^{(0.3331(\ln(\text{hardness}))+6.4676)}$
	Chronic	2618 µg/l	$e^{(0.3331(\ln(\text{hardness}))+5.8743)}$
Nickel, Dissolved	Acute	1513 µg/l	$e^{(0.846(\ln(\text{hardness}))+2.253)}$
	Chronic	168 µg/l	$e^{(0.846(\ln(\text{hardness}))+0.0554)}$
Selenium, Dissolved	Acute	18.4 µg/l	Numeric standards provided, formula not applicable
	Chronic	4.6 µg/l	Numeric standards provided, formula not applicable
Silver, Dissolved	Acute	22.0 µg/l	$\frac{1}{2}\, e^{(1.72(\ln(\text{hardness}))-6.52)}$
	Chronic	3.5 µg/l	$e^{(1.72(\ln(\text{hardness}))-9.06)}$
Zinc, Dissolved	Acute	379 µg/l	$e^{(0.8473(\ln(\text{hardness}))+0.8618)}$
	Chronic	382 µg/l	$e^{(0.8473(\ln(\text{hardness}))+0.8699)}$

Regulation 93 – 303(d) List and Total Maximum Daily Loads

This stream segment is not listed on the Division's 303(d) list of water quality impacted streams.

Regulation 94 – 305(b) Monitoring and Evaluation List

This stream segment is not listed on the Division's 305(b) list for monitoring and evaluation.

IV. Receiving Stream Information

Low Flow Analysis

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, and is used in developing limitations based on an acute standard. The 7-day average low flow, 7E3, represents the seven-day average low flow recurring in a 3 year interval, and is used in developing limitations based on a Maximum Weekly Average Temperature standard (MWAT). The chronic low flow, 30E3, represents the 30-day average low flow recurring in a three-year interval, and is used in developing limitations based on a chronic standard.

As flow data for the receiving stream is not available, the local water commissioner was contacted to obtain an estimate of the low flow for this receiving water. According to discussions with the local Water Commissioner, Box Elder Creek has a low flow of zero.

Table A-5a

Low Flows for Box Elder Creek at the Greatrock North Water and Sanitation District WWTF

Low Flow (cfs)	*Annual*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
1E3 Acute	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30E3 Chronic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7E3 Chronic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The ratio of the low flow of Box Elder Creek to the Greatrock North Water and Sanitation District WWTF design flow is 0:1

Note that since the low flow has been determined to be zero, the ambient water quality discussion is unnecessary and has therefore been deleted in this WQA. This is explained in more detail under the Technical Information discussion in Section VI.

Mixing Zones

The amount of the available assimilative capacity (dilution) that may be used by the permittee for the purposes of calculating the WQBELs may be limited in a permitting action based upon a mixing zone analysis or other factor. These other factors that may reduce the amount of assimilative capacity available in a permit are: presence of other dischargers in the vicinity; the presence of a water diversion

downstream of the discharge (in the mixing zone); the need to provide a zone of passage for aquatic life; the likelihood of bioaccumulation of toxins in fish or wildlife; habitat considerations such as fish spawning or nursery areas; the presence of threatened and endangered species; potential for human exposure through drinking water or recreation; the possibility that aquatic life will be attracted to the effluent plume; the potential for adverse effects on groundwater; and the toxicity or persistence of the substance discharged.

Unless a facility has performed a mixing zone study during the course of the previous permit, and a decision has been made regarding the amount of the assimilative capacity that can be used by the facility, the Division assumes that the full assimilative capacity can be allocated. Note that the review of mixing study considerations, exemptions and perhaps performing a new mixing study (due to changes in low flow, change in facility design flow, channel geomorphology or other reason) is evaluated in every permit and permit renewal.

If a mixing zone study has been performed and a decision regarding the amount of available assimilative capacity has been made, the Division may calculate the water quality based effluent limitations (WQBELs) based on this available capacity. In addition, the amount of assimilative capacity may be reduced by T&E implications.

Since the receiving stream has a zero low flow as calculated above, the WQBELs would be equal to the WQS, and therefore consideration of full or reduced assimilative capacity is inconsequential.

Ambient Water Quality

The Division 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*, and as outlined in the Division's Policy for Characterizing Ambient Water Quality for Use in Determining Water Quality Standards Based Effluent Limits (WQP-19). The ambient water quality was not assessed for Box Elder Creek because the background in-stream low flow condition is zero, and because no ambient water quality data are available for Box Elder Creek upstream of the Greatrock North Water and Sanitation District WWTF discharge.

V. Facility Information and Pollutants Evaluated

Facility Information

The Greatrock North Water and Sanitation District WWTF is located at in the SW1/4 of S1, T1S, R65W, of the 6th PM; 16373 Rayburn Street in Hudson, CO; at 39.5330° latitude North and 104.3640° longitude West in Adams County. The current design capacity of the facility is 0.0504 MGD (0.078 cfs). There is some treatment for Nitrates proposed and achieved through detention and settling in the lined North Detention Pond. The technical analyses that follow include assessments of the assimilative capacity based on this design capacity.

Due to the in-stream low flow of zero, the assimilative capacities during times of low flow are not affected by nearby contributions. Therefore, modeling nearby facilities in conjunction with this facility was not necessary.

Pollutants of Concern

Pollutants of concern may be determined by one or more of the following: facility type; effluent characteristics and chemistry; effluent water quality data; receiving water quality; presence of federal effluent limitation guidelines; or other information. Parameters evaluated in this WQA may or may not appear in a permit with limitations or monitoring requirements, subject to other determinations such as a reasonable potential analysis, mixing zone analyses, 303(d) listings, threatened and endangered species listings or other requirement as discussed in a permit rationale.

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

- Total Residual Chlorine
- Fecal Coliform
- E. coli
- Nitrite and Nitrate
- Metals and Cyanide
- Electrical Conductivity (EC)
- Sodium Adsorption Ratio (SAR) and Adjusted SAR (SAR-adj)

There are no site-specific in-stream water quality standards for BOD_5 or $CBOD_5$, TSS, percent removal, and oil and grease for this receiving stream. Thus, assimilative capacities were not determined for these parameters. The applicable limitations for these pollutants can be found in Regulation No. 62 and will be applied in the permit for the discharge of the wastewater from the reverse osmosis process.

During assessment of the facility, nearby facilities, and receiving stream water quality, no additional parameters were identified as pollutants of concern.

VI. Determination of Water Quality Based Effluent Limitations (WQBELs)

Technical Information

Note that the WQBELs developed in the following paragraphs, are calculations of what an effluent limitation may be in a permit. The WQBELs for any given parameter will be compared to other potential limitations (federal Effluent Limitations Guidelines, State Effluent Limitations, or other applicable limitation) and typically the more stringent limit is incorporated into a permit. If the WQBEL is the more stringent limitation, incorporation into a permit is dependent upon a reasonable potential analysis.

In-stream background data and low flows evaluated in Sections II and III are used to determine the assimilative capacity of Box Elder Creek near the Greatrock North Water and Sanitation District WWTF for pollutants of concern, and to calculate the WQBELs. For all parameters except ammonia, it is the Division's approach to calculate the WQBELs using the lowest of the monthly low flows (referred to as the annual low flow) as determined in the low flow analysis. For ammonia, it is the standard procedure of the Division to determine monthly WQBELs using the monthly low flows, as the regulations allow the use of seasonal flows.

The Division'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 Division to calculate the WQBELs, 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:

$$M_2 = \frac{M_3 Q_3 - M_1 Q_1}{Q_2}$$

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 WQBEL
M_3 = Water Quality Standard, or other maximum allowable pollutant concentration

When Q_1 equals zero, Q_2 equals Q_3, and the following results:

$$M_2 = M_3$$

Because the low flow (Q_1) for Box Elder Creek is zero, the WQBELs for Box Elder Creek for the pollutants of concern are equal to the in-stream water quality standards.

A more detailed discussion of the technical analysis is provided in the pages that follow.

Calculation of WQBELs

Where a WQBEL is calculated to be a negative number and interpreted to be zero, the Division standard procedure is to allocate the water quality standard to prevent further degradation of the receiving waters. The Division's Restoration and Protection Unit investigates issues of water quality standard exceedances. This Unit is tasked with determining if the exceedances are valid and placing the receiving stream on the Clean Water Act Section 303(d) list of impaired waters, if appropriate. If the receiving water is placed on the State's 303(d) list, the Assessment Unit is tasked with developing the Total Maximum Daily Loads (TMDLs) and the Waste Load Allocations (WLAs) to be distributed to the affected facilities.

Chlorine: The mass-balance equation was used to determine the WQBELs for chlorine.

The WQBELs for total residual chlorine were determined to equal the in-stream water quality standards as shown in Table A-6.

Table A-6

Chlorine Assimilative Capacities

Parameter	Q_1 *(cfs)*	Q_2 *(cfs)*	Q_3 *(cfs)*	M_1 *(mg/l)*	M_3 *(mg/l)*	M_2 *(mg/l)*
Acute Chlorine	0.00	0.1	0.1	0	0.019	***0.019***
Chronic Chlorine	0.00	0.1	0.1	0	0.011	***0.011***

Fecal Coliform and/or *E. coli*: Available studies indicate that *Escherichia coli (E. coli)*, which is a subset of fecal coliform, is a better predictor of potential human health impacts from waterborne pathogens. Currently, the Water Quality Control Commission has adopted standards for both pathogens and intends that dischargers will have the option of either parameter being used in establishing their effluent limits.

The WQBELs for fecal coliform and/or *E. coli* were determined to equal the in-stream water quality standard as shown in Table A-7.

Table A-7

Fecal Coliform and /or *E. coli* Assimilative Capacities

Parameter	Q_1 *(cfs)*	Q_2 *(cfs)*	Q_3 *(cfs)*	M_1 *(#/100 ml)*	M_3 *(#/100 ml)*	M_2 *(#/100 ml)*
Fecal Coliform	0.00	0.1	0.1	1	2000	***2,000***
E. coli	0.00	0.1	0.1	1	630	***630***

Temperature:
As shown in Table 5, the 7-day low flow (7E3) is 0, so the discharge is to effluent dependent waters therefore in accordance with Regulation 31.14(14), no temperature limitations are required.

Nitrite and Nitrate
Contamination sources in the area include septic system leech fields from the residential dwellings and agricultural sources, introducing nitrite and nitrate as pollutants of concern. Alluvial well water is the source water of the facility and is susceptible to the percolation of these pollutants through the soil and into the groundwater. Thus, the Division is evaluating Nitrite and Nitrate for which there are standards. The stream segment standard for acute Nitrite is 0.5 mg/l. There is no site-specific in-stream water quality standard for Nitrate for this receiving stream and therefore the Statewide Basic Standard for Nitrate found in Regulation 31, *The Basic Standards and Methodologies for Surface Water*, will be evaluated in this WQA. The Statewide Basic Standard for Nitrate is 100 mg/l based on the agricultural classification of the receiving stream.

The WQBEL for Nitrate and Nitrite was determined to equal the in-stream water quality standard as shown in Table A-8.

Table A-8

Nitrate and Nitrite Assimilative Capacities

Parameter	*Q_1 (cfs)*	*Q_2 (cfs)*	*Q_3 (cfs)*	*M_1 (mg/l)*	*M_3 (mg/l)*	*M_2 (mg/l)*
NO3, mg/l	0.00	0.1	0.1	1	100	***100.0***
NO2, mg/l	0.00	0.1	0.1	1	0.5	***0.5***

Metals and Cyanide: Industrial processes at this facility generate wastewater containing metals and cyanide. Thus, the Division is evaluating cyanide and all metals for which there are standards. Note, however, that the Agency for Toxic Substances and Disease Registry has determined that while chromium in the trivalent form occurs naturally in the environment, hexavalent chromium is produced by industrial processes. Industrial processes at this facility would not generate hexavalent chromium and therefore the evaluation for chromium is limited to the trivalent form. NOTE THAT CYANIDE AND HEX CHROMIUM MAY ALSO BE PRESENT AT CERTAIN OPERATIONSUsing the mass-balance equation provided in the beginning of Section V, the low flows and background concentrations contained in Section III, and the in-stream standards for metals and cyanide as shown in Section II, the WQBELs were calculated. The data used and the resulting WQBELs, M_2, are set forth in Table A-9a for chronic standards and in Table A-9b for acute standards.

Table A-9a

Chronic WQBELs for Metals and Cyanide

Parameter	*Q_1 (cfs)*	*Q_2 (cfs)*	*Q_3 (cfs)*	*M_1*	*M_3*	*M_2*
As, TR (µg/l)	0.00	0.1	0.1	0.00	100	***100***
Cd, Dis (µg/l)	0.00	0.1	0.1	0.00	6.20	***6.2***
Cr+3, Dis (µg/l)	0.00	0.1	0.1	0.00	231	***231***
Cr+6, Dis (µg/l)	0.00	0.1	0.1	0.00	11	***11***
Cu, Dis (µg/l)	0.00	0.1	0.1	0.00	29	***29***
Fe, TR (µg/l)	0.00	0.1	0.1	0.00	1000	***1000***
Pb, Dis (µg/l)	0.00	0.1	0.1	0.00	11.00	***11***
Mn, Dis (µg/l)	0.00	0.1	0.1	0.00	2618	***2618***
Hg, Tot (µg/l)	0.00	0.1	0.1	0.00	0.01	***0.01***
Ni, Dis (µg/l)	0.00	0.1	0.1	0.00	168	***168***
Se, Dis (µg/l)	0.00	0.1	0.1	0.00	4.6	***4.6***
Ag, Dis (µg/l)	0.00	0.1	0.1	0.00	3.5	***3.5***
Zn, Dis (µg/l)	0.00	0.1	0.1	0.00	382	***382***
B, Tot (mg/l)	0.00	0.1	0.1	0.00	0.75	***0.75***

Table A-9b

Acute WQBELs for Metals and Cyanide

Parameter	Q_1 *(cfs)*	Q_2 *(cfs)*	Q_3 *(cfs)*	M_1	M_3	M_2
Cd, Dis (µg/l)	0.00	0.1	0.1	0.00	19.00	***19***
Cr+3, Dis (µg/l)	0.00	0.1	0.1	0.00	1773	***1773***
Cr+6, Dis (µg/l)	0.00	0.1	0.1	0.00	16	***16***
Cu, Dis (µg/l)	0.00	0.1	0.1	0.00	50	***50***
CN, Free (µg/l)	0.00	0.1	0.1	0.00	5	***5***
Pb, Dis (µg/l)	0.00	0.1	0.1	0.00	281.00	***281***
Mn, Dis (µg/l)	0.00	0.1	0.1	0.00	4738	***4738***
Ni, Dis (µg/l)	0.00	0.1	0.1	0.00	1513	***1513***
Se, Dis (µg/l)	0.00	0.1	0.1	0.00	18.4	***18.4***
Ag, Dis (µg/l)	0.00	0.1	0.1	0.00	22	***22***
Zn, Dis (µg/l)	0.00	0.1	0.1	0.00	379	***379***
Sulfide (mg/l)	0.00	0.1	0.1	0.00	0.002	***0.002***

Agricultural Use Parameters (SAR, Na and EC):

Section 31.11(1)(a)(iv) of *The Basic Standards and Methodologies for Surface Waters* (Regulation No. 31) includes the narrative standard that State surface waters shall be free of substances that are harmful to the beneficial uses or toxic to humans, animals, plants, or aquatic life. The interpretation of these conditions (i.e., "no harm to plants" and "no harm to the beneficial uses") and how they were to be applied in permits were contemplated by the Division as part of an Agricultural Work Group, and culminated in the most recent policy entitled *Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops* (hereafter the Narrative Standards policy)

Based on available information, the water in Box Elder Creek is used for irrigation water. The evaluation of the suitability (i.e., quality) of irrigation water is complex and involves the detailed understanding of the interactions of plant tolerances, soil types, and agricultural management practices. Irrigation water has two properties – salinity and sodicity – that can have concurrent impacts on the irrigated crop beneficial use. The Division has thus determined that two parameters, specifically electrical conductivity (EC) and sodium, are the best parameters to regulate in discharge permits to control levels of salts to minimize both the loss of irrigated crop yield and the sodium hazard.

In order to establish limits for EC and sodium, the Division must: (1) determine the most sensitive crop usually grown in the area downstream from the discharge and determine the corresponding EC of irrigation water (EC_w) threshold value for no reduction in yield below100%; and (2) determine the SAR based on the EC_w value and calculate the maximum sodium that can be discharged, with consideration of existing water quality, to prevent the exceedance of the SAR.

Electrical Conductivity: The electrical conductivity (EC) is also known as specific conductance, conductance, conductivity, or specific conductivity. Crops have varying sensitivity to electrical conductivity. Studies have established the maximum conductivity in the water in the root zone that will result in no reduction of crop yield. This value is referred to as the EC saturation extract or EC_e. However, the EC_e is not the same as the EC of the irrigation water (EC_w). The EC_w is the maximum conductivity in the irrigation water that will result in no reduction in crop yield.

Common crop EC_w thresholds are reproduced from the Narrative Standards policy, and are summarized in Table A-10a.

Table A-10a

Maximum EC_w That Will Not Reduce The 100% Yield of Selected Irrigated Crops

Common Colorado Crops	*Irrigation Water Electrical Conductivity (EC_w)*
Beans	0.7
Onion	0.8
Corn (grain)	1.1
Potato	1.1
Corn (silage)	1.2
Alfalfa	1.3
Wheat	4.0
Sugarbeet	4.7
Barley	5.3

The EC_w that is used in the development of permit limits is determined based on the most sensitive of the EC_w's for the crops grown in the area. Based on available information from the local water commissioner, the Colorado Water Conservation Board and Colorado Division of Water Resources, for waters originating from **Box Elder Creek** and used for crop irrigation, beans was determined to be the most sensitive crop.

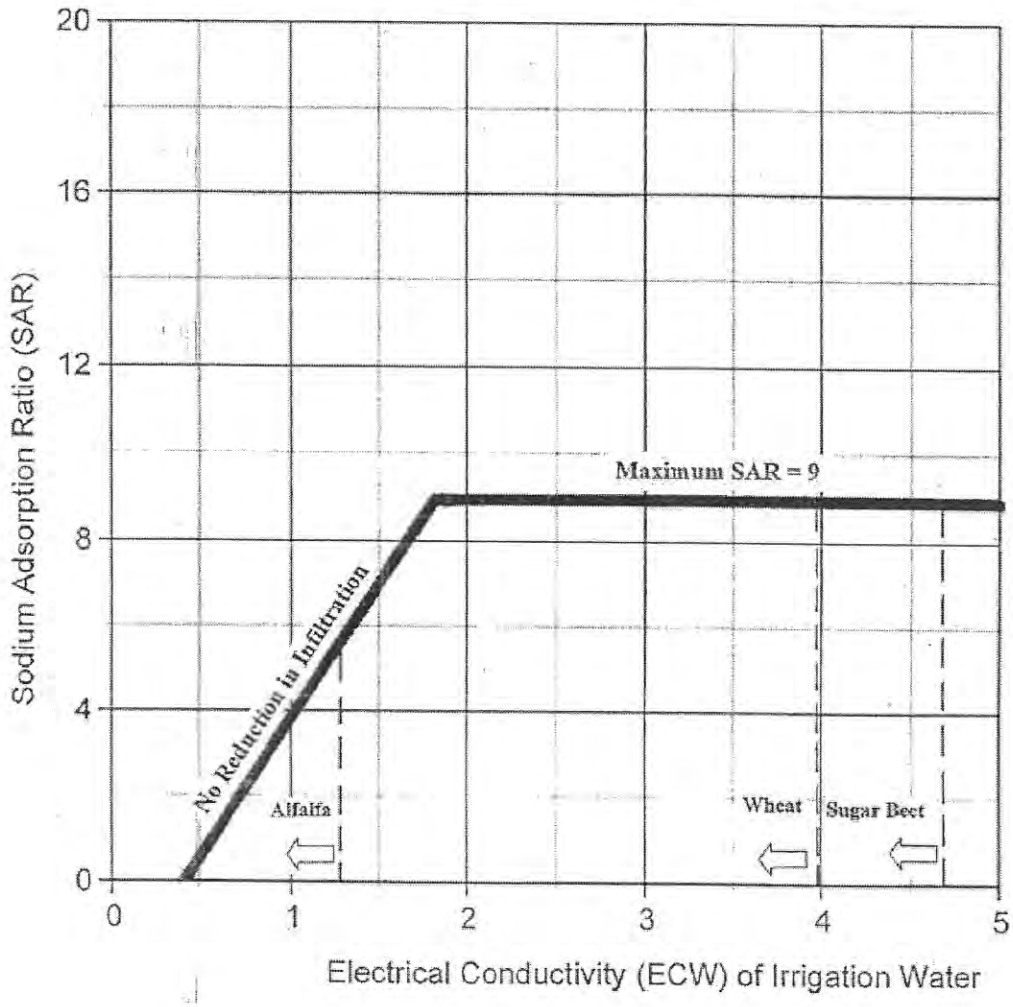
For **Box Elder Creek**, the EC limit is calculated using the mass balance equation found at the beginning of Section IV of this analysis. The data used and the resulting calculations of the EC limit, M_2, are set forth in the table below. Note that in accordance with the Division's Narrative Standards policy, the EC limit will be imposed as a chronic (30-day average) limit and therefore chronic low flows were used together with 85th percentile EC concentrations when calculating the limit.

Sodium and SAR – SAR means Sodium Adsorption Ratio, which is a representation of the relative proportion of sodium cations to calcium and magnesium cations (also known as the "sodium hazard").

The SAR standard is established using Figure A-2, which is reproduced herein from the Narrative Standards policy. Specifically, the EC_w 0.7 which corresponds to the EC_w for the most sensitive crop of Beans was used to establish a SAR standard of 2.

SAR is the ratio of sodium to a combination of calcium and magnesium, and therefore is a parameter that has no units. The equation for SAR follows:

Figure A-2: Relative Rate of Water Infiltration as Affected by EC_w and SAR with Modification to Show Upper Limit for SAR = 9



$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

The values for sodium (Na^{+}), calcium (Ca^{++}) and magnesium (Mg^{++}) in this equation are expressed in units of milliequivalents per liter (meq/l). Generally, data for sodium, calcium and magnesium are reported in terms of mg/l, which must then be converted to calculate the SAR. The conversions are:

$$\text{meq/l} = \frac{Concentration\ in\ mg/l}{Equivalent\ weight\ in\ mg/meq}$$

Where the equivalent weights are determined based on the atomic weight of the element divided by the ion's charge:

Na^{+} = 23.0 mg/meq (atomic weight of 23, charge of 1)
Ca^{++} = 20.0 mg/meq (atomic weight of 40.078, charge of 2)
Mg^{++} = 12.15 mg/meq (atomic weight of 24.3, charge of 2)

Because SAR is a ratio, the Division acknowledges that additions to the effluent in the form of calcium can allow for significant and toxic amounts of sodium to be discharged while the SAR ratio is still met. To prevent this from occurring, Division procedures are to determine sodium limits using the SAR standard and the existing quality for calcium and magnesium.

First, the Division must determine the maximum sodium in-stream that may be discharged. Because of the inverse relationship between Na^{+} and the combination of Ca^{++} and Mg^{++} in the SAR equation, the existing quality for calcium and magnesium has been determined to equal the 15th percentile. Box Elder Creek is an effluent dominant stream and therefore data submitted by the facility of the effluent was used for the calcium and magnesium existing quality as follows:

Ca^{++} = 117 mg/l ÷ 20.0 mg/meq = 5.9 meq/l
Mg^{++} = 34.9 mg/l ÷ 12.15 mg/meq = 2.9 meq/l

Solving for the maximum allowable in-stream sodium concentration is accomplished by revising the previously set forth SAR equation, to solve for sodium, specifically:

$$Na^{+}_{ReceivingWater} = SAR_{ReceivingWater} \times \sqrt{\frac{Ca^{++}_{ReceivingWater} + Mg^{++}_{ReceivingWater}}{2}}$$

$$Na^{+}_{ReceivingWater} = 2 \times \sqrt{\frac{5.9 + 2.9}{2}} = 4.2 \text{ meq/l}$$

This converts to a maximum allowable in-stream sodium concentration in **Box Elder Creek** of 96.6 mg/l (4.2 eq/l x 23 mg/meq).

The mass balance equation found at the beginning of Section IV can then be used to determine the sodium effluent limit. Note that in accordance with the Division's Narrative Standards policy, the SAR standard is imposed as a chronic standard and therefore the maximum allowable in-stream sodium concentration is determined as a chronic value. Therefore, the chronic low flows in **Box Elder Creek** were used together with the 85th percentile of the in-stream sodium concentration when executing the calculations. The data used and the resulting calculations of the allowable discharge concentrations, M_2, are set forth in the following table.

Parameter	Q_1 *(cfs)*	Q_2 *(cfs)*	Q_3 *(cfs)*	M_1 *(mg/l)*	M_3 *(mg/l)*	M_2 *(mg/l)*
Na, mg/l	0.00	0.0	0.0	0	96.6	96.6

In addition to the sodium limits, monitoring and reporting for calcium and magnesium, as well as calculating and reporting the SAR, will be required as part of a future permit and therefore these parameters are also included as PELs.

Bicarbonate and Adjusted SAR (SAR-adj): Studies by the Colorado State University Cooperative Extension and by other entities have found that high proportions of sodium to calcium and magnesium in total dissolved solids negatively impacts plant growth and may contribute to reduced yields in farm land over time. Additionally, high bicarbonate concentrations also adversely affect plant growth because bicarbonate combined with calcium and magnesium will precipitate out, leaving a higher concentration of sodium in the water. For this reason, monitoring and reporting of the bicarbonate ion concentration, in mg/l, is required in this permit. Note the bicarbonate ion must be measured pursuant to a modified alkalinity test (Alkalinity can be measured via procedures approved pursuant to 40 CFR Part 136), that involves the titration of alkalinity in an acidic environment, thereby resulting solely in a measure of bicarbonate alkalinity.

The analytical results for the bicarbonate ion are also of interest because they are used in the calculation of the adjusted SAR (SAR-adj). The SAR-adj offers a better insight into the change in calcium in the soil-water due to addition by dissolution of calcium from soil carbonates and silicates, or loss of calcium from soil-water by precipitation as carbonates. The SAR-adj can be used to more correctly predict potential infiltration problems due to relatively high sodium (or low calcium and/or magnesium) in irrigation water. The equation for calculation of SAR-adj is:

$$SAR\text{-}adj = \frac{Na^{+}}{\sqrt{\frac{Ca_{x} + Mg^{++}}{2}}}$$

Where:

Na^{+} = Sodium in the irrigation water reported in meq/l (see the formula for meq/l previously provided)

Mg^{++} = Magnesium in the irrigation water reported in meq/l (see the formula for meq/l previously provided)

Ca_x = Ca_x represents calcium (in meq/l) in the applied irrigation water but modified due to salinity of the applied water (EC_w), its HCO_3^{-}/Ca^{++} ratio, and the estimated partial pressure of CO_2 in the surface few millimeters of soil (PCO_2 = 0.0007 atmospheres)

Because the Ca_x value must be determined based on the EC_w and the ratio of HCO_3^{-}/Ca^{++}, the permittee will be required to determine the EC_w (in dS/m) and the ratio of HCO_3^{-}/Ca^{++}, where the HCO_3^{-} and Ca^{++} are expressed in units of meq/l. The following equations are used:

Ca^{++} = Calcium in the irrigation water reported in meq/l (see the formula for calcium meq/l previously provided)

HCO_3^{-} = Bicarbonate in the irrigation water reported in meq/l, where the equivalent weight conversion is determined by dividing the concentration in mg/l by the atomic weight of 61 and the charge of 1

Ultimately, the EC_w and the HCO_3^-/Ca^{++} ratio (calculated by dividing the HCO_3^- in meq/l by the Ca^{++} in meq/l) are used to obtain determine the Ca_x using meq/l) are used to obtain determine the Ca_x using Table A-10b.

Table A-10b – Modified Calcium Determination for Adjusted Sodium Adsorption Ratio

CALCIUM CONCENTRATION (Ca_x) EXPECTED TO REMAIN IN NEAR-SURFACE SOIL-WATER FOLLOWING IRRIGATION WITH WATER OF GIVEN HCO_3/Ca RATIO AND EC_w [1, 2, 3]													
		Salinity of applied water (EC_w)(dS/m)											
		0.1	**0.2**	**0.3**	**0.5**	**0.7**	**1.0**	**1.5**	**2.0**	**3.0**	**4.0**	**6.0**	**8.0**
Ratio of HCO_3/Ca	**.05**	13.20	13.61	13.92	14.40	14.79	15.26	15.91	16.43	17.28	17.97	19.07	19.94
	.10	8.31	8.57	8.77	9.07	9.31	9.62	10.02	10.35	10.89	11.32	12.01	12.56
	.15	6.34	6.54	6.69	6.92	7.11	7.34	7.65	7.90	8.31	8.64	9.17	9.58
	.20	5.24	5.40	5.52	5.71	5.87	6.06	6.31	6.52	6.86	7.13	7.57	7.91
	.25	4.51	4.65	4.76	4.92	5.06	5.22	5.44	5.62	5.91	6.15	6.52	6.82
	.30	4.00	4.12	4.21	4.36	4.48	4.62	4.82	4.98	5.24	5.44	5.77	6.04
	.35	3.61	3.72	3.80	3.94	4.04	4.17	4.35	4.49	4.72	4.91	5.21	5.45
	.40	3.30	3.40	3.48	3.60	3.70	3.82	3.98	4.11	4.32	4.49	4.77	4.98
	.45	3.05	3.14	3.22	3.33	3.42	3.53	3.68	3.80	4.00	4.15	4.41	4.61
	.50	2.84	2.93	3.00	3.10	3.19	3.29	3.43	3.54	3.72	3.87	4.11	4.30
	.75	2.17	2.24	2.29	2.37	2.43	2.51	2.62	2.70	2.84	2.95	3.14	3.28
	1.00	1.79	1.85	1.89	1.96	2.01	2.09	2.16	2.23	2.35	2.44	2.59	2.71
	1.25	1.54	1.59	1.63	1.68	1.73	1.78	1.86	1.92	2.02	2.10	2.23	2.33
	1.50	1.37	1.41	1.44	1.49	1.53	1.58	1.65	1.70	1.79	1.86	1.97	2.07
	1.75	1.23	1.27	1.30	1.35	1.38	1.43	1.49	1.54	1.62	1.68	1.78	1.86
	2.00	1.13	1.16	1.19	1.23	1.26	1.31	1.36	1.40	1.48	1.54	1.63	1.70
	2.25	1.04	1.08	1.10	1.14	1.17	1.21	1.26	1.30	1.37	1.42	1.51	1.58
	2.50	0.97	1.00	1.02	1.06	1.09	1.12	1.17	1.21	1.27	1.32	1.40	1.47
	3.00	0.85	0.89	0.91	0.94	0.96	1.00	1.04	1.07	1.13	1.17	1.24	1.30
	3.50	0.78	0.80	0.82	0.85	0.87	0.90	0.94	0.97	1.02	1.06	1.12	1.17
	4.00	0.71	0.73	0.75	0.78	0.80	0.82	0.86	0.88	0.93	0.97	1.03	1.07
	4.50	0.66	0.68	0.69	0.72	0.74	0.76	0.79	0.82	0.86	0.90	0.95	0.99
	5.00	0.61	0.63	0.65	0.67	0.69	0.71	0.74	0.76	0.80	0.83	0.88	0.93
	7.00	0.49	0.50	0.52	0.53	0.55	0.57	0.59	0.61	0.64	0.67	0.71	0.74
	10.00	0.39	0.40	0.41	0.42	0.43	0.45	0.47	0.48	0.51	0.53	0.56	0.58
	20.00	0.24	0.25	0.26	0.26	0.27	0.28	0.29	0.30	0.32	0.33	0.35	0.37
	30.00	0.18	0.19	0.20	0.20	0.21	0.21	0.22	0.23	0.24	0.25	0.27	0.28

[1] Adapted from Suarez (1981).

[2] Assumes a soil source of calcium from lime ($CaCO_3$) or silicates; no precipitation of magnesium, and partial pressure of CO_2 near the soil surface (P_{CO2}) is0.0007 atmospheres.

[3] Ca_x, HCO_3, Ca are reported in meq/l; ECw is in dS/m (deciSiemens per meter).

Because values will not always be quantified at the exact EC_w or HCO_3^-/Ca^{++} ratio in the table, the resulting Ca_x must be determined based on the closest value to the calculated value. For example, for a calculated EC_w of 2.45 dS/m, the column for the EC_w of 2.0 would be used. However, for a calculated EC_w of 5.1, the corresponding column for the EC_w of 6.0 would be used. Similarly, for a HCO_3^-/Ca^{++} ratio of 25.1, the row for the 30 ratio would be used.

The Division acknowledges that some effluents may have electrical conductivity levels that fall outside of this table, and others have bicarbonate to calcium ratios that fall outside this table. For example, some data reflect HCO_3^-/Ca^{++} ratios greater than 30 due to bicarbonate concentrations reported greater than 1000 mg/l versus calcium concentrations generally less than 10 mg/l (i.e., corresponding to HCO_3^-/Ca^{++} ratios greater than 100). Despite these high values exceeding the chart's boundaries, it is noted that the higher the HCO_3^-/Ca^{++} ratio, the greater the SAR-adj. Thus, using the Ca_x values corresponding to the final row containing bicarbonate/calcium ratios of 30, the permittee will actually calculate an SAR-adj that is less than the value calculated if additional rows reflecting HCO_3^-/Ca^{++} ratios of greater than 100 were added.

Although the SAR-adj of the downstream irrigation water is of interest to the Division, the Division does not intend to impose in-stream monitoring for calculations of SAR-adj at this time. However, monitoring for calcium, sodium, magnesium, bicarbonate and conductivity is required under this permit to enable the Division to later calculate an effluent SAR-adj for use in correlating the effluent discharge to in-stream SAR-adj values that will be available based on in-stream sampling conducted by other entities.

VII. Antidegradation Evaluation

As set out in *The Basic Standards and Methodologies for 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 analysis.

According to the *Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin*, stream segment COSPMS05a is 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 OR PELs analysis, antidegradation review requirements have been met and no further antidegradation evaluation is necessary.

VIII. References

Regulations:

The Basic Standards and Methodologies for Surface Water, Regulation 31, Colorado Department Public Health and Environment, Water Quality Control Commission, effective May 31, 2008.

Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin, Regulation No. 38, Colorado Department Public Health and Environment, Water Quality Control Commission, effective March 01, 2008.

Water-Quality-Limited Segments Requiring Total Maximum Daily Loads, Regulation 93, Colorado Department Public Health and Environment, Water Quality Control Commission, effective April 30, 2008.

Colorado's Monitoring and Evaluation List, Regulation 94, Colorado Department Public Health and Environment, Water Quality Control Commission, effective April 30, 2008.

Policy and Guidance Documents:

Antidegradation Significance Determination for New or Increased Water Quality Impacts, Procedural Guidance, Colorado Department Public Health and Environment, Water Quality Control Division, December 2001.

Memorandum Re: First Update to (Antidegradation) Guidance Version 1.0, Colorado Department Public Health and Environment, Water Quality Control Division, April 23, 2002.

Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops, Colorado Department Public Health and Environment, Water Quality Control Division Policy Number WQP-24, effective March 10, 2008.

Policy for Characterizing Ambient Water Quality for Use in Determining Water Quality Standards Based Effluent Limits, Colorado Department Public Health and Environment, Water Quality Control Division Policy Number WQP-19, effective May 2002.

PUBLIC NOTICE SHEET

Troy L Whitmore, 141 Union Blvd. Suite 150, Lakewood, CO 80228, PHONE: (303) 987-0835; PERMIT NO.: CO-047708; Adams County

Denial of Permit application for proposed discharge to surface water

DRAFTER: Maura McGovern

DISCHARGE: To Box Elder Creek