

STATE OF COLORADO

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Dedicated to protecting and improving the health and environment of the people of Colorado

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Colorado Department
of Public Health
and Environment

February 9, 2012

Mr. James Walcutt
Encana Oil and Gas (USA) Inc.
370 17th Street, Suite 1700
Denver, Colorado 80202

**RE: Certification, Colorado Discharge Permit System – Produced Water Treatment Facilities
Permit Number COG84000 Certification Number: COG840004**

Dear Mr. Walcutt:

Enclosed please find a copy of the permit certification for the Encana Oil and Gas (USA) Inc (Encana) operations near Rifle, CO, discharging to West Mamm Creek, which was issued under the Colorado Water Quality Control Act. This permit certification under General Permit COG840000 replaces the older certification under the Minimum Industrial General Permit (MINDI) COG600633. **Please read the enclosed permit and certification, including the fact sheet.** The Division holds the permittee legally liable for all permit requirements.

The following information describes how the limitations and permit requirements were developed.

Facility Information:

- **Industry Description**

The wastewater treatment facility (WWTF) operated by Encana in the Hunter Mesa area will treat wastewater associated with natural gas production from the Hunter Mesa and Grass Mesa fields. The primary purpose of the facility is to treat, store, and recycle produced water generated from oil and gas gathering operations. The treated water may be used in dust suppression activities, fracing activities, evaporated, or discharged to West Mamm Creek. This facility is subject to Colorado Department of Public Health and Environment regulations pertaining to solid waste sites and facilities and will operate under a Certificate of Designation. The facility is also subject to permitting by the Air Pollution Control Division. The discharge of treated water to adjacent surface waters requires a discharge permit from the Water Quality Control Division (WQCD).

- **Treatment Facility Description**

Produced water from wells is currently delivered via trucks and pipelines to the WWTF on Hunter Mesa. The water is treated for oil removal and stored in lined holding ponds. Some of the water may be used for drilling and hydraulic fracturing. The volume of produced water has steadily increased over the past years and the evaporation ponds do not have enough capacity to handle all of the water. Encana has been developing plans to implement expanded water treatment operations for the additional volumes of water. A reverse osmosis (RO) plant will be brought in to treat the water and will then be discharged to West Mamm Creek. The treated water will first be discharged to the lined holding ponds, tested, and as permit requirements are met, discharged to the creek through a pipeline to Outfall 001A. Additionally, the Lake Fox lined holding pond does have an overflow spillway connected to West Mamm Creek which will serve as outfall 002A.

- **Chemical Usage**

The application identified the following chemicals which are added to the water flow after dissolved air flotation and before entrance into the lined, storage pond. The MSDS documents for these chemicals were provided in the permit application. The MSDS sheets have been reviewed and the following chemicals are been approved for use.

Chemical Name	Purpose	Constituents of Concern
Hydrochloric Acid	Membrane regeneration	pH
Filtrapure Acid Cleaner	Acid cleaning reagent	pH, Nitrogen oxides, metallic oxides, salts, toxicity
Filtrapure desulfur	Acid desulphuring reagent	unknown
Filtrapure TF	Membrane cleaning detergent	pH, Nitrogen oxides, metallic oxides, salts, toxicity
Caustic soda	Membrane washing reagent	pH

Chemicals deemed acceptable for use in waters that will or may be discharged to waters of the State are acceptable only when used in accordance with all state and federal regulations, and in strict accordance with the manufacturer's site-specific instructions.

Basis of Certification Limitations:

- **Stream Segment Information**

The discharge is to West Mamm Creek, within Segment COLCLC04A of the Lower Colorado River Sub-basin, Lower Colorado River Basin, found in the Classifications and Numeric Standards for the Lower Colorado River River Basin (Regulation No. 37; last effective update effective June 30, 2010). Segment 4A is reviewable and is classified for the following beneficial uses: Recreation Class N, Aquatic Life – Class 2 Cold, Water Supply, and Agriculture. West Mann Creek is tributary to Mann Creek, which is tributary to the Colorado River just above Rifle, CO.

- **Technology Based Standards**

The limitations for oil and grease and total suspended solids are from Regulation 62, which apply to all discharges that would be covered under this General Permit.

- **Water Quality Standards**

Limitations for metals and inorganics are based on the water quality standards specific to stream segment COLCLC04a. Note that for many of the metals, the standards relate to the hardness of the receiving stream. Since the initial receiving stream is a zero low flow stream, most times of the year the only water that is present will be the effluent discharge. Since the discharge is made up or RO permeate, it is clean water with a very low hardness (approaching zero). However, as some blending with the RO brine, or with the addition of other additives that will be needed to be done in order to meet the WET limitations (the organisms on which the WET testing is to occur cannot live in a pure, ionic imbalanced water) a zero hardness will not be seen in the discharge. Hardness data for West Mamm Creek was obtained from the following stations:

Colorado Riverwatch, 4017, West Mann Creek, 3/8/05 and 6/16/05, 332 mg/l and 276 mg/l respectively, average 304
 Colorado Riverwatch, 4016, Mann Creek North, 3/8/05 – 10/11/05 (10 data points), range 152 – 500 mg/l, average 320
 Colorado Riverwatch, 4018, Middle Mann Creek, 4/12/05 – 10/11/05 (3 data points), range 356 – 418 mg/l, average 385
 Colorado Riverwatch, 4019, East Mann Creek, 5/17/05 and 8/9/05, 264 and 234 mg/l respectively, average 249
 CDPHE Station 11149B, Mann Creek at Garfield Cty Airport, 3/16/00, 440 mg/l

As there were only two data points on West Mann Creek, the Division looked at other nearby stations for comparison. The hardness data from West Mann Creek appears to be in line with other data on Mann Creek and therefore was used to determine the TVS values for metals. The hardness used in the equations was 300 mg/l, based solely on the data for West Mann Creek as it is the most direct receiving water. The calculations are provided below.

Parameter	In-Stream Water Quality Standard		TVS Formula: Hardness (mg/l) as CaCO ₃ = 300
	Aluminum, Total Recoverable	Acute	10071 µg/l
Chronic		1438 µg/l	$e^{(1.3695(\ln(\text{hardness}))-0.1158)}$

Cadmium, Dissolved	Acute	7.1 µg/l	$[1.136672-0.041838\ln(\text{hardness})]e^{(0.9151(\ln(\text{hardness}))-3.1485)}$
	Chronic	0.97 µg/l	$[1.101672-0.041838\ln(\text{hardness})]e^{(0.7998(\ln(\text{hardness}))-4.4451)}$
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	38 µg/l	$e^{(0.9422(\ln(\text{hardness}))-1.7408)}$
	Chronic	23 µg/l	$e^{(0.8545(\ln(\text{hardness}))-1.7428)}$
Lead, Dissolved	Acute	209 µg/l	$[1.46203-0.145712\ln(\text{hardness})]e^{(1.273(\ln(\text{hardness}))-1.46)}$
	Chronic	8.1 µg/l	$[1.46203-0.145712\ln(\text{hardness})]e^{(1.273(\ln(\text{hardness}))-4.705)}$
Manganese, Dissolved	Acute	4305 µg/l	$e^{(0.3331(\ln(\text{hardness}))+6.4676)}$
	Chronic	2379 µg/l	$e^{(0.3331(\ln(\text{hardness}))+5.8743)}$
Nickel, Dissolved	Acute	1186 µg/l	$e^{(0.846(\ln(\text{hardness}))+2.253)}$
	Chronic	132 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	13 µg/l	$\frac{1}{2} e^{(1.72(\ln(\text{hardness}))-6.52)}$
	Chronic	2.1 µg/l	$e^{(1.72(\ln(\text{hardness}))-9.06)}$
Uranium, Dissolved	Acute	8062 µg/l	$e^{(1.1021(\ln(\text{hardness}))+2.7088)}$
	Chronic	5036 µg/l	$e^{(1.1021(\ln(\text{hardness}))+2.2382)}$
Zinc, Dissolved	Acute	366 µg/l	$0.978e^{(0.8525(\ln(\text{hardness}))+1.0617)}$
	Chronic	317 µg/l	$0.986e^{(0.8525(\ln(\text{hardness}))+0.9109)}$

Note that there are no known drinking water intakes on Mann Creek or its tributaries, and although there are intakes on the Colorado River, the dilution factor would eliminate them from being applied in this certification. Therefore limitations for dissolved iron, sulfate, and manganese will not be applied. Note that limits for manganese based on aquatic life (above table) will be applied. Additionally, the 10 mg/l limit for nitrate will not be applied and the 100 mg/l limit based on agricultural uses will be substituted. For total recoverable arsenic, the 0.02-10 standard will not be applied, and instead the 100 µg/l limit for agricultural uses will be substituted.

For organic parameters, only the aquatic life limits will be applied.

- **Antidegradation**

Because the receiving water is reviewable, an antidegradation evaluation must occur. The facility was not in place as a discharger as of September 2000, and therefore any consideration of this discharge being present as of the antidegradation baseline date is not considered. The limitations based on the antidegradation review will be determined to be 15% of the water quality standard.

- **Narrative Standards**

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.

Agricultural Protection

For the Ag Policy, 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 titled Implementing Narrative Standards in Large Permits for the Protection of Irrigated Crops (hereafter the Narrative Standards policy)

Based on available information, the water in Mann 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 absorption ratio (SAR), 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 “standards” and limits for EC and SAR, 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 below 100%; and (2) determine the SAR based on the EC_w value, 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 E_{Ce}. However, the E_{Ce} 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.

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 information from the Colorado Decision Support Systems (CDSS) website, there are active intakes on Mann Creek that are used to irrigate grass fields. Although the specific grasses are not identified, the lowest allowable EC for various grasses, as listed in the Ag Policy, is 1.5 dS/m. This value also corresponds to the ambient condition of Mann Creek (CDPHE station – 1 sample – 1.56 dS/m). Therefore the limitation for EC will be added to the permit at this value.

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 equation for SAR follows:

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

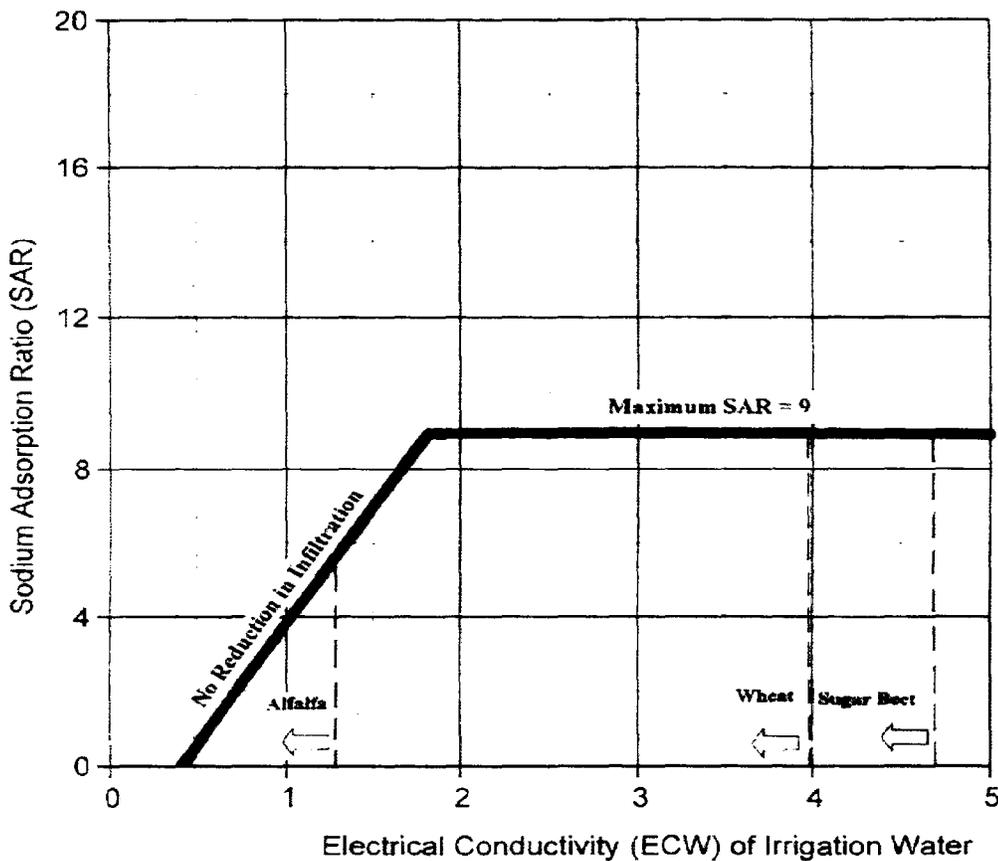
The values for sodium (Na⁺), calcium (Ca⁺⁺) and magnesium (Mg⁺⁺) in this equation are expressed in units of milliequivalents per liter (meq/l). Generally, data for sodium, calcium and magnesium are reported in terms of mg/l, which must then be converted to calculate the SAR. The conversions are:

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

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)

The SAR standard is established using the SAR/EC equation, shown graphically in the figure below, which is reproduced herein from the Narrative Standards Policy. Specifically, the WQBEL calculated for EC_w was used to establish a SAR standard of 8.17. Since the allowable SAR value is tied to the actual EC of the effluent, the EC/SAR equation (SAR = (7.1 * EC) – 2.48) will be the SAR limit in the permit, however the allowable SAR of the effluent will be capped at the value above or at 9, whichever is less. Due to the effect of bicarbonate on the available calcium and magnesium, limitations will be expressed as adjusted SAR, which accounts for bicarbonate. This is explained in more detail in the fact sheet and permit documents.



Note that due to the implementation of the limits for SAR and EC, limitations for TDS based on agricultural protection are no longer necessary. However, as the discharge is to the Colorado River basin, overall limits for TDS are required at either 500 mg/l, 1 ton per day, or 350 tons per year. As meeting the EC and WET limits will require low TDS concentrations, it is assumed that these criteria will be met. Reporting requirements will be required during this permit term.

Whole Effluent Toxicity

For WET testing, although the proposed treatment would remove almost all pollutants from the wastewater, this in fact may be toxic to aquatic life as the discharge water will be too clean to support aquatic life due to ionic imbalances. The permittee will likely need to adjust the RO system to allow for some pass through of salts to maintain a suitable ionic balance, or may have to blend some of the RO brine back into the effluent or add some salts back into the discharge water prior to release. This will need to be done in order to have a chemically balanced discharge that will pass a WET test, but also maintain compliance with other permit limitations. Because of the zero low flow condition of the receiving stream, and a more permanent discharge scenario, chronic WET testing will be required.

General Information:

- **Permit Action Fees** : The Annual Fee for this certification is \$9,880 and is invoiced every July. Do not pay this now as an invoice will be sent shortly.
- **Changes to the Certification** – Any changes that need to be made to the certification page – changes in outfalls, monitoring requirements, etc., must be submitted using the “Permit and Certification Modification form” available on our website: coloradowaterpermits.com, and signed by the legal contact.
- **Discharge Monitoring Report (DMR)** forms will be mailed out within the next month. Reports must be submitted **monthly** as long as the certification is in effect. The permittee shall provide the Division with any additional monitoring data on the permitted discharge collected for entities other than the Division. This will be supplied to the Division within 48 hours of the receipt of the data by the permittee. If forms have not been received, please contact the Division at 303-692-3517.

