

# Colorado Hydraulic Fracturing State Review

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## INTRODUCTION

In 1990, the Interstate Oil Compact Commission (IOCC) and the U.S. Environmental Protection Agency (USEPA) jointly published a Study of State Regulation of Oil and Gas Exploration and Production Waste, which contained guidelines for the regulation of oil and gas exploration and production wastes by the IOCC member states (the “1990 Guidelines”). The published guidelines, developed by state, environmental and industry stakeholders, provided the basis for the State Review Process, a multi-stakeholder review of state exploration and production (E&P) waste management programs against the guidelines. The purposes of the State Review Process are to document the successes of states in regulating E&P wastes and to offer recommendations for program improvement. In 1994, the guidelines were updated and revised (the “1994 Guidelines”) by the IOCC, now named the Interstate Oil and Gas Compact Commission (IOGCC).

In 1999, administration of the State Review Process devolved to a non-profit, multi-stakeholder organization named State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER). STRONGER again revised, expanded and updated the Guidelines, which were accepted by the IOGCC and published in June 2000 as Guidelines for the Review of State Oil and Natural Gas Environmental Regulatory Programs (the “2000 Guidelines”). In 2005, STRONGER again revised, expanded and updated the Guidelines (the “2005 Guidelines”).

In 2009, STRONGER formed a Hydraulic Fracturing Workgroup consisting of stakeholders to review issues associated with hydraulic fracturing and develop guidelines for state regulatory programs to address identified issues. After several meetings and a round of public comment, the workgroup submitted to STRONGER a set of guidelines that represented the consensus of the workgroup. In 2010, STRONGER distributed the workgroup’s guidelines (the “2010 Hydraulic Fracturing Guidelines”) for state regulation of hydraulic fracturing. Those guidelines were used as the basis of this review.

In April 2011, the Colorado Oil and Gas Conservation Commission (COGCC) volunteered to have its hydraulic fracturing program reviewed by STRONGER. The Colorado oil and gas regulatory program has undergone one prior review. The report of the initial review of the Colorado oil and gas regulatory program was published in 1996.

The current review began with a questionnaire that was sent to the COGCC. The questionnaire had been prepared by the STRONGER Board. STRONGER intended the questionnaire to capture the status of the Colorado program relative to the 2010 Hydraulic Fracturing Guidelines. The COGCC prepared a response to the questionnaire, which was then sent to the review team.

In June through September 2011 an eight-person review team appointed by STRONGER conducted a review to evaluate the COGCC program compared to the 2010 Hydraulic Fracturing Guidelines. The review team consisted of three members and five official observers. The three team members were: Lori Wrotenbery, Oklahoma Corporation Commission; Wilma Subra, Subra Co., New Iberia, Louisiana; and Jim Collins, Independent Petroleum Association of America. The official observers were: Bruce Baizel, Earthworks; Tom Maunder, Alaska Oil and

Gas Conservation Commission; Ken Wonstolen, Beatty and Wozniak; Kate Fay, USEPA Region VIII; and Jerry Strahan, Bureau of Land Management (BLM).

The review team conducted a meeting, the in-state portion of the review, in the conference facilities of the Colorado State Land Board in Denver, Colorado on June 23, 2011. Mr. David Neslin, Director of the COGCC, and staff members Mr. Thom Kerr, Ms. Deb Baldwin, Mr. Stuart Ellsworth and Mr. Mike Leonard presented an overview of hydraulic fracturing requirements in Colorado. Following their presentations, they responded to questions from the team members and official observers. In addition to the Colorado state representatives who participated in the review and the review team, there were eight industry, nine government and twenty-two citizen attendees who observed the proceedings. The meeting was also broadcast over the internet. Following the meeting and after reviewing the written materials provided by the COGCC, the team members compiled this review report.

This is the report of the review of the Colorado program against the 2010 Hydraulic Fracturing Guidelines of STRONGER. Appendix A is a glossary of acronyms used in the report. Appendix B contains Colorado's written response to the STRONGER questionnaire.

## **EXECUTIVE SUMMARY**

A multi-stakeholder review team has completed an in-depth review of the Colorado hydraulic fracturing regulatory program. During the review of Colorado's regulation of hydraulic fracturing, the review team members and official observers were granted full access to staff of the Colorado Oil and Gas Conservation Commission (COGCC), and all questions were answered in a responsive and open manner.

The review team has concluded that the Colorado program is well managed and professional and generally meets the 2010 Hydraulic Fracturing Guidelines. The review team identified a number of program strengths that warrant special recognition. The review team also made some specific recommendations for improvement in the program based on the guidelines.

### **Program Strengths**

During the review, the review team identified strengths of the Colorado program, which also are noted in several of the report's findings. The following offers an overview of some of the Colorado program's strengths.

#### **1. Comprehensive Regulation Update**

In 2008, the COGCC completed a review and update of its regulations. Numerous sections of the regulations related to hydraulic fracturing were revised. The regulations now contain standards that address current hydraulic fracturing practices. The COGCC is commended for this comprehensive program update.

#### **2. Chemical Information**

Rule 205 requires operators to inventory chemicals kept at well sites during drilling, completion, and workover operations, including hydraulic fracturing. This information must be provided to agency officials promptly upon request and also to certain health care professionals who sign a confidentiality agreement. This rule allows government officials and medical professionals to investigate and address allegations of chemical contamination associated with hydraulic fracturing, while protecting proprietary information.

#### **3. Bradenhead Annulus Pressure Monitoring**

Rule 341 requires operators to monitor and record bradenhead annulus pressure during hydraulic fracturing operations, and to promptly report to COGCC increases in pressure greater than 200 psig. These requirements help to ensure that groundwater is

protected and that prompt action is taken if conditions arise that could lead to the subsurface release of hydraulic fracturing fluids.

#### **4. Management of Field Staff**

The COGCC management staff demonstrated a high level of experience and competence. They have provided field inspectors with the levels of training and types of equipment to enable them to properly perform their duties. They appear to properly prioritize field inspector work. The managers demonstrated high standards of performance.

#### **5. Website**

The information available on the COGCC website is comprehensive. It includes statutes, rules, policies, guidance, orders, maps, database information, permits, inspection reports, enforcement actions, and information on spills and releases. It also includes a regular Staff Report that contains monthly statistics and information concerning activities around the state, announces and reports on meetings and events, gives status reports on projects and investigations, explains policy changes, describes the organization of the COGCC, and provides various statistical reports on permitting and drilling activities. Last year more than one million people visited the COGCC website. The COGCC is commended for its use of internet capabilities.

### **Program Recommendations**

The following are the primary areas where recommendations are made by the review team for improvements of the Colorado hydraulic fracturing program. Discussion and findings for these recommendations can be found in the various sections of the report. Readers are encouraged to review the specific discussion and finding for each recommendation.

#### **1. Minimum Surface Casing Depths**

The setting of surface casing to an appropriate depth is critical for meeting anticipated pressures and for protecting fresh water aquifers. In determining minimum surface casing setting depths, the COGCC considers all available information, including: a state-wide ground water atlas and area-specific aquifer studies prepared by the Colorado Geologic Survey (CGS); a statewide database of water well information maintained by the Colorado Division of Water Resources (DWR); and oil and gas well electric logs on file with the COGCC. As part of this process, the COGCC reviews information on all water wells and one representative oil and gas well within at least one mile of the new well.

The review team recommends that the COGCC work with stakeholders to review how available information is used to determine minimum surface casing depths and how those depths assure that casing and cementing procedures are adequate to protect fresh groundwater. This review should include a determination of the percentage of surface casing depths determined on the basis of existing water well depths, oil and gas well electric logs, area aquifer studies, or a combination of these sources of information. Additionally, this review should determine the percentage of wells in which the surface casing is set through the base of the freshwater aquifer.

## **2. Maximum Surface Casing Depth**

There is no standard for the maximum depth to which surface casing can be run.

The review team recommends that the COGCC review any past instances where problems occurred in the setting or cementing of surface casing in a well to be hydraulically fractured, where casing or cement failures occurred during hydraulic fracturing, and other available relevant information, and consider whether establishing a maximum surface casing depth may be in order to prevent well control or cementing problems that may arise when lost circulation zones or gas-producing formations are penetrated before surface casing is set and cemented

## **3. Completion Reports**

Form 5A, the Completed Interval Report, is used to report the completion of a well. The form includes a space for the narrative reporting of a brief summary of the formation treatment, but is not specific regarding pressures or materials. The review team recommends that the COGCC revise form 5A to include the identification of materials used, aggregate volumes of fracturing fluids and proppant used, and fracture pressures recorded.

## **4. Evaluate NORM**

The report of the 1996 review of Colorado's oil and gas E&P waste management program contained a recommendation that the COGCC gather information on the occurrence and level of NORM to enable the state to develop an appropriate program for the regulation of NORM. The review team recommends that the COGCC include an evaluation of NORM in wastes associated with hydraulic fracturing operations as part of the study recommended in the report of the 1996 review.

## **5. Availability of Water**

The review team recommends that the COGCC and the DWR jointly evaluate available sources of water for use in hydraulic fracturing. Given the significant water supply issues in this arid region, this project should also include an evaluation of whether or not availability of water for hydraulic fracturing is an issue and, in the event that water supply is an issue, how best to maximize water reuse and recycling for oil and gas hydraulic fracturing. COGCC should consider posting the results of that evaluation on the Hydraulic Fracturing Information page of the COGCC's website.

# **HYDRAULIC FRACTURING**

## **I. BACKGROUND**

Oil and gas development has a long history in Colorado. The first oil and gas well in the state was drilled in 1862. Oil and gas production from shale, tight sands, coal beds and other formations occurs throughout much of the state. There are approximately 45,000 active oil and gas wells in Colorado. In 2009 Colorado ranked fourth in the United States for natural gas production and ninth for oil production.

The Colorado Oil and Gas Conservation Commission (COGCC) is the regulatory agency in Colorado responsible for the regulation of oil and gas. The COGCC was created by the Oil and Gas Conservation Act in 1951. The Oil and Gas Conservation Act, as amended in recent years, gives the COGCC the authority to regulate oil and gas operations to protect public health, safety, and welfare. This authority specifically includes protection of the environment and wildlife resources.

Hydraulic fracturing has occurred in Colorado since 1947. Nearly all active wells in Colorado have been hydraulically fractured. The COGCC serves as first responder to incidents and complaints concerning oil and gas wells, including those related to hydraulic fracturing. To date, the COGCC has not verified any instances of groundwater being contaminated by hydraulic fracturing.

## **II. GENERAL**

The COGCC is a division of the Colorado Department of Natural Resources (DNR). DNR programs include, in addition to the COGCC, the Colorado Geologic Survey, the Colorado State Land Board, the Colorado Water Conservation Board, the Division of Forestry, the Division of Reclamation, Mining and Safety, the Division of Water Resources, the Division of Parks and Wildlife, and the Inter-Basin Compact Committee.

The COGCC regulates oil and gas well drilling and production activities in a manner that prevents waste, safeguards mineral property rights, protects the environment, and ensures public safety. In 2007 the Colorado General Assembly passed legislation to increase the COGCC's regulatory authority and oversight obligations to better address the potential adverse impacts that can accompany oil and gas development. In response to this legislation, the COGCC undertook a comprehensive updating of its regulations. The regulatory process lasted 16 months. Eighty-

five parties participated in the rulemaking process. There were 24 days of hearings. Hydraulic fracturing was one of the areas addressed in the rulemaking.

Jurisdiction for hydraulic fracturing is divided among several entities. The Division of Water Resources (DWR) within the DNR oversees the administration of both surface and groundwater, including water produced by and used in oil and gas activities. The Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE) has jurisdiction over discharges to surface waters. The CDPHE/WQCD has responsibility for permitting surface discharges to waters of the state under the Colorado Pollution Discharge Elimination System Permitting program. The WQCD was not a participant in the review. The COGCC reported that a Memorandum of Agreement (MOA) on response to spills and releases to surface waters has been in place for many years between the COGCC and the WQCD and has served both agencies well. The MOA transfers reporting and initial oversight responsibilities to the COGCC staff since they are in the field inspecting oil and gas facilities. These responsibilities include responding to spills and releases associated with hydraulic fracturing.

Another MOA has been developed with the Bureau of Land Management (BLM). This MOA addresses the permitting of wells on federal lands. Approximately 15 percent of the wells in Colorado are located on federal lands.

The COGCC has been delegated primacy from the USEPA for the Class II Underground Injection Control (UIC) program.

### **Finding 9.2.1.**

The COGCC shares expertise on aquifer depths with BLM, and the two agencies coordinate the activities of their field staffs.

## **STANDARDS**

In determining minimum surface casing setting depths, the COGCC considers all available information, including the CGS water well atlas and aquifer studies, the CDWR water well database, and the COGCC oil and gas well electric logs. The CGS has developed a general atlas containing available statewide aquifer information, which it has supplemented with detailed aquifer studies in a number of basins. The COGCC staff uses this aquifer information to help determine the aquifer depths to be covered by surface casing. In addition, all water wells are required to be registered with the CDWR, and there are 300,000 to 400,000 water wells in the CDWR database. The COGCC staff reviews this data base for information on all water wells within at least one mile of the proposed oil and gas well, which provides additional characterization of groundwater in the area. Finally, COGCC staff reviews existing electric logs from oil and gas wells, searching within at least a one-mile radius until a representative logs found, which provides additional information on groundwater depths in the area. As

mentioned above, the COGCC updated its regulations in 2008. As a result, regulations that establish requirements pertaining to hydraulic fracturing include the following:

Rule 205 requires operators to inventory chemicals kept at well sites during drilling, completion, and workover operations, including hydraulic fracturing. This information must be provided to agency officials promptly upon request and also to certain health care professionals who sign a confidentiality agreement. This rule allows government officials and medical professionals to investigate and address allegations of chemical contamination associated with hydraulic fracturing, while protecting proprietary information.

Rule 317 requires wells to be cased with steel pipe and the casing to be surrounded by cement to create a hydraulic seal and to ensure that gas and fluids do not leak into shallower aquifers. Further, operators are required to run cement bond logs on production casing to confirm that the cement has properly isolated the hydrocarbon bearing zones.

Rule 317A requires operators in the DJ Basin Fox Hills Protection Area in northeastern Colorado to run surface casing to specified minimum depths to provide well control and protect the Fox Hills Aquifer.

Rule 317B imposes mandatory setbacks, baseline sampling, and other enhanced environmental protections on oil and gas development occurring near sources of public drinking water. These requirements provide protection for public water supplies and help ensure that they are not inadvertently contaminated by oil and gas development.

Rule 318A requires operators in the Greater Wattenberg Basin to conduct baseline water well sampling for certain infill or boundary wells. This rule provides protection for water wells located near oil and gas development.

Rule 324 contains general prohibitions on significant adverse impacts to state waters and violations of state water quality standards and classifications.

Rule 341 requires operators to monitor and record bradenhead annulus pressure during hydraulic fracturing operations, and to promptly report to the COGCC increases in pressure greater than 200 psig. The monitoring allows the operator to know if the casing, cement and other equipment that may be in the well are containing the fracturing fluids in the well and directing them to the formation(s) to be treated. These requirements help to ensure that groundwater is protected and that prompt action is taken if the well experiences a mechanical failure that could allow the subsurface release of hydraulic fracturing fluids that could enter and contaminate underground sources of fresh water.

Rule 608 requires operators developing coalbed methane (CBM) wells to identify and assess plugged and abandoned wells within one-quarter mile, to sample nearby water wells, and to meet other special requirements before, during, and after operations to ensure that gas or water does not leak to the ground surface or into groundwater.

Rules 902 through 905 impose requirements for pit operation, permitting, reporting, lining, closure, monitoring, and secondary containment to ensure that fluids in pits do not contaminate soil, groundwater, or surface water. These requirements help ensure that any flowback of hydraulic fracturing fluids is properly contained.

Rule 1101 through 1103 provide regulatory requirements for the installation, operation and abandonment of flowlines, including those used for the transportation of hydraulic fracturing fluids.

In addition to the standards set by rule, the Commission has issued various orders that establish requirements pertaining to hydraulic fracturing. A series of more than 20 orders, for example, require San Juan Basin operators to collect and analyze water well samples before and after drilling coalbed methane wells. The COGCC and operators are currently working on a sampling plan for areas where horizontal wells are being drilled.

#### **Finding 9.2.1.1.**

The CGS has developed an atlas containing statewide aquifer information as well as several area-specific aquifer studies. In addition, the CDWR database contains information on water wells throughout the state, and the COGCC database contains electric logs from oil and gas wells across the state. In setting minimum surface casing depths, the COGCC considers all available information for every well permitting application, including the CGS groundwater atlas and aquifer studies, the CDWR water well database, and the oil and gas well electric logs.

#### **Recommendation 9.2.1.1.**

The review team recommends that the COGCC work with stakeholders to review how available information is used to determine minimum surface casing depths and how those depths assure that casing and cementing procedures are adequate to protect fresh groundwater. The setting of surface casing to an appropriate depth is critical for meeting anticipated pressures and for protecting fresh water aquifers. The recommended review should include a determination of the percentage of surface casing depths determined on the basis of existing water well depths, oil and gas well electric logs, area aquifer studies, or a combination of these sources of information. Additionally, this review should determine the percentage of wells in which the surface casing is set through the base of the freshwater aquifer. (STRONGER Guidelines, Section 9.2.1.)

#### **Finding 9.2.1.2.**

There is no standard for the maximum depth to which surface casing can be run. Instead, the COGCC staff reviews the proposed surface casing program for each well and determines what is appropriate based on the local geological conditions.

**Recommendation 9.2.1.2.**

The review team recommends that the COGCC review any past instances where problems occurred in the setting or cementing of surface casing in a well to be hydraulically fractured, where casing or cement failures occurred during hydraulic fracturing, and other available relevant information, and consider whether establishing a maximum surface casing depth may be in order to prevent well control or cementing problems that may arise when lost circulation zones or gas-producing formations are penetrated before surface casing is set and cemented. (STRONGER Guidelines, Section 9.2.1.)

**Finding 9.2.1.3.**

The review team commends the COGCC for the development of Rule 205 regarding the inventory of chemicals used at the well site and the availability of information concerning those chemicals to government officials and medical professionals conducting investigations.

**Finding 9.2.1.4.**

The review team commends the COGCC on its program to require bradenhead annulus pressure monitoring, recording, and reporting during hydraulic fracturing. These requirements allow the operators of the fracturing operation to know if the casing, cement and other equipment that may be in the well are containing the fracturing fluids in the well and directing them to the formation(s) to be treated, and to initiate prompt action in the event of the occurrence of a problem.

**Finding 9.2.1.5.**

The COGCC requires identification of potential conduits for fluid migration in some circumstances, for example, the requirement to identify plugged and abandoned wells with ¼ mile of CBM wells and gas seeps and springs within two miles of such wells. The COGCC GIS map system has a layer that shows the bottomhole location, and the COGCC staff includes this information in their review of historic plugged and abandoned wells within ¼ mile. Also, for horizontal wells, the COGCC adds permit conditions requiring pressure monitoring of all producing wells within 500 feet for a 24-hour period during hydraulic fracturing.

**Recommendation 9.2.1.5.**

The COGCC should consider whether there are additional circumstances or expanded areas where operators should be required to identify and address potential conduits for fluid migration in the area of hydraulic fracturing. (STRONGER Guidelines, Section 9.2.1.)

## **REPORTING**

The COGCC rules and conditions of approval on drilling permits require that a number of notices and reports be submitted to the Commission. These include notification of the inspector 24 hours before drilling begins so that the inspector has an opportunity to witness operations.

The rules require the filing of a completion report (Form 5A) after hydraulic fracturing is completed. Other requirements relating to spill reporting, accidents and loss of well control are also specified in the rules.

The COGCC encourages operators to participate in reporting to FracFocus, the reporting system developed by the IOGCC and the Ground Water Protection Council (GWPC), where operators can report chemicals used during hydraulic fracturing on a well-by-well basis. The COGCC indicated that 35 percent of the operators in Colorado have contributed data to FracFocus so far this year. They encourage 100 percent participation. In August, Governor Hickenlooper directed the COGCC to develop a regulation that will provide for public disclosure of hydraulic fracturing chemicals.

### **Finding 9.2.2.1.**

In some areas, but apparently not all, conditions of approval on drilling permits require notification to the inspector before the commencement of hydraulic fracturing operations. It is not clear whether and how the inspector is notified of hydraulic fracturing operations on a well that is being recompleted.

### **Recommendation 9.2.2.1.**

The review team recommends that COGCC review its notification requirements to ensure they are sufficient to allow for the presence of field staff to monitor hydraulic fracturing operations. (STRONGER Guidelines, Section 9.2.2)

### **Finding 9.2.2.2.**

Form 5A is used to report the completion of a well. The form includes a space for the narrative reporting of a brief summary of the formation treatment, but is not specific regarding pressures or materials.

### **Recommendation 9.2.2.2.**

The review team recommends that the COGCC revise form 5A to include the identification of materials used, aggregate volumes of fracturing fluids and proppant used, and fracture pressures recorded. (STRONGER Guidelines, Section 9.2.2.)

## **STAFFING AND TRAINING**

The COGCC is organized into seven work units, each under the supervision of a manager. These units include Information Technology, Permits/Technical Services, Hearings, Fiscal, Engineering, Environmental, and Field Inspections. Sixty-nine staff members are assigned to the COGCC. Twenty three of those positions are located in regional offices throughout the oil and gas producing areas of the state. Approximately 6,000 permits were issued and approximately 2,500 wells were drilled in 2010.

There are 15 field inspectors assigned across the state, including: a manager; a supervisor and three inspectors assigned to each of three geographical areas (northeast, northwest and south) outside of Denver and two environmental inspection specialists who focus on reclamation issues. Nearly all inspections are unannounced. Inspectors are equipped with laptop computers, global positioning system (GPS) devices, pressure gauges, range finders and cameras.

During 2010 COGCC staff conducted 17,157 inspections, with 16,702 of those being performed by the inspection group. These included 161 inspections of cementing during well abandonment, 105 inspections of surface casing cementing, 47 inspections to monitor bradenhead annulus pressure, 48 inspections to witness mechanical integrity testing, 328 drilling inspections, 12 stimulation inspections, 171 inspections witnessing mechanical integrity testing at UIC wells, 749 routine UIC inspections, 144 inspections related to complaints, 262 inspections related to environmental issues, 2,923 well site reclamation inspections, and 11,728 inspections of producing wells. The results of all inspections can be queried on the intranet or internet.

A training matrix has been established for employees.

### **Finding 9.2.3.1.**

The COGCC is commended for its effective management of field staff, and especially for providing field inspectors with the levels of training and types of equipment to enable them to properly perform their duties. Managers appear to properly prioritize field inspector work and maximize the number of inspections in the different regions of the state. The managers interviewed displayed a high level of experience and competence, and demonstrated high standards of performance.

## **PUBLIC INFORMATION**

In 1994 a legislative audit of websites showed agency websites were designed to only provide statistics. In 1997 COGCC undertook a stakeholder study to evaluate information management needs. When that study was completed, they proceeded to develop a new web-based system to

provide information to the public, to support decision making at the agency, and to serve staff in remote locations. The resulting system at COGCC includes intranet capabilities for the COGCC staff and internet access for stakeholders. Laptop computers that act as servers are provided to field staff. All data queries are live except those performed on the laptops, which are as current as the last synchronization with the parent database.

In support of the upgraded system, COGCC has undertaken on-going data clean-up projects, and paper records have been scanned and made available on the internet. Information available online includes statutes, rules, policies, guidance, orders, maps, Staff Reports, database information, permits, inspection reports, enforcement actions, and information on spills and releases.

Last year more than one million people visited the COGCC website. The web page includes a page on hydraulic fracturing with links to various documents prepared by COGCC as well as links to hydraulic fracturing information posted on the web by other organizations.

The COGCC staff frequently attends public meetings to discuss oil and gas issues. Recently the meeting subject matter has increasingly involved hydraulic fracturing. In the past year COGCC staff has attended meetings in 13 counties, particularly in areas with new oil and gas well development.

The COGCC holds Commission meetings every five weeks (ten meetings per year). These meetings are held in Denver as well as in the different producing areas around the state. Commission meetings are open to the public.

For each Commission meeting the COGCC staff prepares a Staff Report that contains monthly statistics and information concerning activities around the state. This informative document announces and reports on meetings and events, gives status reports on projects and investigations, explains policy changes, describes the organization of the COGCC, and provides various statistical reports on permitting and drilling activities. The Staff Report is posted on the COGCC website.

The COGCC meets quarterly with the CDPHE, WQCC and WQCD to update them on the implementation of ground water standards and classifications for the oil and gas industry and to discuss topics of mutual interest. The COGCC also prepares a written report for the WQCC which is presented annually at one of their public hearings. These reports are posted on the COGCC website.

#### **Finding 9.2.4.1.**

The COGCC has amended numerous sections of the regulations to address hydraulic fracturing concerns. These rules are posted on the COGCC website.

**Recommendation 9.2.4.1.** The review team recommends that the COGCC consider highlighting, on the Hydraulic Fracturing Information page or elsewhere on its website, a summary of the changes to the rules that pertain to hydraulic fracturing so that the public can have a better understanding of the program. (STRONGER Guidelines, Section 9.2.4.)

#### **Finding 9.2.4.2.**

The COGCC makes good use of its web site to distribute information to the public and to staff. The Staff Report is a particularly good example of this great effort.

#### **Recommendation 9.2.4.2.**

To further enhance the website, the review team recommends that the COGCC consider:

1. developing the capability for the public to make a comment or file a complaint through the website and post guidance for the public on the complaint response process;
2. adding average complaint response time to the monthly Staff Report; and
3. adding a link to the STRONGER website on the Hydraulic Fracturing Information page.

### **III. WATER AND WASTE MANAGEMENT**

The DWR in the DNR administers the program governing the use of water in Colorado. Water that is used for hydraulic fracturing must come from a legal source. It is typically purchased or leased from the holder of a water right.

The recycling of water produced during oil and gas operations is encouraged. Over 50% of hydraulic fracturing flowback water is recycled. Multi-well pits are provided for in Rules 903 and 907, with the intent of promoting recycling. All pits except certain drilling pits must be lined. Pipelines between multi-well pit locations are sometimes used to transfer water used for hydraulic fracturing

There are 290 Class II disposal wells in Colorado. Hydraulic fracturing fluid that is not recycled is disposed in Class II wells or evaporation pits, or at commercial disposal facilities. In addition, some E&P wastes, including hydraulic fracturing fluids, are transported between Colorado and the states of Wyoming, New Mexico, Utah, and Kansas. No hydraulic fracturing flowback water is discharged to surface waters.

Naturally occurring radioactive materials (NORM) have not been considered to be an issue of concern in Colorado. The COGCC has authority for NORM if it is part of E&P waste. In general, elevated concentrations of NORM in hydraulic fracturing wastes have not been considered a problem. The COGCC indicated that they will consult with the CDPHE if and when the NORM issue arises.

**Finding 9.3.1.**

The DWR, which administers the water use program, did not participate in the review. More information on available sources of water for hydraulic fracturing would assist the state, the industry, and other stakeholders in understanding and addressing the issue.

**Recommendation 9.3.1.**

The review team recommends that the COGCC and DWR jointly evaluate available sources of water for use in hydraulic fracturing. Given the significant water supply issues in this arid region, this project should also include an evaluation of whether or not availability of water for hydraulic fracturing is an issue and, in the event that water supply is an issue, how best to maximize water reuse and recycling for oil and gas hydraulic fracturing. COGCC should consider posting the results of that evaluation on the Hydraulic Fracturing Information page of the COGCC's website. (STRONGER Guidelines, Section 9.3.)

**Finding 9.3.2.**

The report of the 1996 review of Colorado's oil and gas E&P waste management program contained a recommendation that the COGCC gather information on the occurrence and level of NORM to enable the state to develop an appropriate program for the regulation of NORM. When asked the status of that effort, the COGCC indicated that it has not been accomplished.

**Recommendation 9.3.2.**

The review team recommends that the COGCC include an evaluation of NORM in wastes associated with hydraulic fracturing operations as part of the study recommended in the report of the 1996 review. (STRONGER Guidelines, Section 9.3.)

**APPENDIX A**  
**Glossary of Acronyms**

BLM	Bureau of Land Management
CDPHE	Colorado Department of Public Health and Environment
CGS	Colorado Geologic Survey
COGCC	Colorado Oil and Gas Conservation Commission
DNR	Department of Natural Resources
DWR	Division of Water Resources
E&P	Exploration and Production
GPS	Global Positioning System
IOCC	Interstate Oil Compact Commission
IOGCC	Interstate Oil and Gas Compact Commission
MOA	Memorandum of Agreement
STRONGER	State Review of Oil and Natural Gas Environmental Regulations, Inc.
UIC	Underground Injection Control
USEPA	United States Environmental Protection Agency
WQCC	Water Quality Control Commission
WQCD	Water Quality Control Division

## APPENDIX B

### Response of the Colorado Oil & Gas Conservation Commission to the STRONGER Hydraulic Fracturing Questionnaire

June 13, 2011

#### General [9.2]

*1. Has the state evaluated potential **risks associated with hydraulic fracturing**, taking into account factors such as depth of the reservoir to be fractured, proximity of the reservoir to fresh water resources, well completion practices, well design, and volume and nature of fluids?*

#### COGCC response:

Yes, the Colorado Oil & Gas Conservation Commission (COGCC) has previously undertaken such evaluations in adopting and amending numerous regulations, orders, and policies over the years. For example, the COGCC evaluated hydraulic fracturing risks in comprehensively updating its regulations in 2008, in analyzing groundwater quality trends in 2009, in adopting a special notification policy in 2010, and in working on a new groundwater sampling program during 2011. Based upon these evaluations, the COGCC has imposed regulatory requirements addressing a wide range of potential risks.

The COGCC has addressed the risk of fracturing fluids migrating into fresh water aquifers by adopting minimum standards for well construction, casing, and cementing in Rule 317. To further ensure well integrity, well construction, casing, and cementing information are required under Rule 303 as part of an application for permit-to-drill (APD) (Form 2). The COGCC reviews this information to ensure that surface casing is properly set and cemented from at least 50 feet below the base of the aquifer to the ground surface and that production casing is properly set and cemented from the bottom of the well to at least 200 feet above the producing formation. The COGCC also requires operators to run cement bond logs under Rule 317 and to monitor bradenhead annular pressures during hydraulic fracturing under Rule 341.

Across much of Colorado, the risk of fracturing fluid migration is further diminished because the producing zones are separated from fresh water aquifers by thousands of feet of intervening geologic formations. The Colorado Geologic Survey and the Division of Water Resources (DWR) have mapped the aquifers, and the COGCC routinely uses this information in reviewing and conditioning APDs under Rules 303 and 305. The COGCC has also imposed additional restrictions and requirements under Rule 317B, to reduce such risks in surface water supply areas, and under Rule 608, to reduce such risks for shallow coalbed methane (CBM) wells.

Risks associated with the surface handling of fracturing fluids are addressed by regulations governing surface operations and waste management. These regulations impose specific requirements regarding chemical identification (Rule 205), tank signage (Rule 210), secondary containment (Rules 603 and 604), waste pits (Rules 902, 903, 904, and 905), spills and releases (Rule 906), waste management (Rule 907), centralized waste facilities (Rule 908), concentrations and sampling (Rule 910), and stormwater management (Rule 1002). Potential environmental impacts associated with pads, pits, and other surface facilities are also addressed through the Oil and Gas Location Assessment (Form 2A) process under Rule 303.d.

Potential water quality risks are further addressed by the COGCC through an extensive program of ground and surface monitoring that is required by order (Causes 112-138, 156, 157, and others) and regulation (Rules 317B, 318A.e.(4), and 608).

Issues associated with the volatilization of fracturing fluids are addressed by odor regulations governing production equipment and well completions. Rule 805 prohibits the use of certain flow back pits near homes, schools, and hospitals in areas of western Colorado, requires emission control devices on certain produced water tanks in those areas, and mandates the use of green completion practices where adequate reservoir pressure exists.

Finally, Rule 206 requires operators in areas of western Colorado to complete an annual compliance checklist demonstrating ongoing compliance with many of these requirements, including requirements relating to the management of stormwater, odors, and wastes, the protection of surface water supply areas, and the identification of chemicals.

*2. Has the state developed **standards to prevent the contamination** of groundwater and surface water from hydraulic fracturing?*

COGCC response:

Yes, Rule 324 prohibits both significant adverse impacts to state waters and violations of state water quality standards and classifications. This prohibition is supplemented by Rule 341, which requires stimulation fluids to be confined to the objective formations during treatment, and by Rule 317, which mandates well construction, casing, and cementing practices. Rules 317B and 608 provide additional standards for wells in surface water supply areas and shallow coalbed methane formations, respectively.

These ground and surface water protection standards are bolstered by: Rule 902, which requires that pits be constructed and operated to protect state waters from significant environmental impacts; Rule 907, which requires operators to construct and operate waste management facilities to protect state waters from such impacts; and Rule 910, which requires operators to notify the COGCC and submit an investigation and remediation plan where groundwater contaminants exceed the concentrations set forth in Table 910-1. Rules 205, 206, 210, 603, 604, 903, 904, 905, 906, 908, and 1002 impose additional surface operating and waste management standards that help protect ground and surface water.

### **Hydraulic Fracturing Standards [9.2.1]**

*3. Describe how state standards for **casing and cementing** meet anticipated pressures associated with hydraulic fracturing to protect other resources and the environment.*

COGCC response:

Colorado's casing and cementing regulations provide design standards sufficient for all anticipated well control events, including hydraulic fracturing. COGCC engineers review casing and cement designs during well permitting and cement tickets and cement bond logs prior to approving drilling completion reports. Well construction and integrity are also verified in the field through random field inspections by COGCC field inspectors and engineers during cementing and well stimulation activities.

The following COGCC regulations impose statewide casing and cementing requirements for pressure control:

- Rule 317.d requires casing programs to prevent the migration of oil, gas, or water from one horizon to another.
- Rules 317.e & f require surface casing to reach a depth sufficient to protect all fresh water and prevent blowouts or uncontrolled flows.
- Rules 317.h & i specify compressive strength and placement requirements for cement.

- Rule 317.j requires production casing to be pressure tested for anticipated conditions during completion and production.
- Rule 317.o requires a cement bond log on all production casing or, in the case of a production liner, the intermediate casing.

These statewide requirements are supplemented by numerous, area-specific, regulations and policies, including the following:

- Rule 317A.a. applies to the D-J Basin Fox Hills Protection Area in Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Elbert, Jefferson, Morgan, and Weld Counties. It requires that surface casing be run to a minimum depth of 5% of the projected well depth, or 200 feet, whichever is deeper.
- The *Northwest Colorado Notification Policy* is made a condition of approval for all well permits in Chaffee, Delta, Eagle, Garfield, Grand, Gunnison, Jackson, Lake, Mesa, Moffat, Montrose (north of the 48N/49N township line), Routt, Pitkin, Rio Blanco, and Summit Counties. It requires operators to submit prior notice of casing and cementing operations to COGCC's field inspector and field inspection supervisor and email subsequent reports of cement jobs to COGCC's Western Colorado engineering supervisor.
- The *Notice to All Operators Drilling Williams Fork Formation Wells in Garfield County, Surface Casing Depth and Modification of Leakoff Test Requirements* requires a minimum surface casing setting depth equivalent to 10% of the proposed well depth for all wells in Garfield County. For wells in the smaller Rulison Field Overpressured Area, the minimum depth is 1100 feet.
- The *Notice to Operators Drilling Mesa Verde Group or Deeper Wells in the Mamm Creek Field Area in Garfield County, Well Cementing Procedure and Reporting Requirements* requires operators to submit a special notice for COGCC approval prior to completing wells in the area. For wells within the smaller East Mamm Creek Area, the notice requires a minimum surface casing setting depth equivalent to 15% of the proposed well depth, or 500 feet below the depth of any water well within one mile, whichever is greater. Additionally, formation integrity tests are required, and intermediate casing must be installed in certain circumstances.

4. Discuss how the program identifies and, where deemed appropriate, manages risks associated with **potential conduits for fluid migration** in the area of hydraulic fracturing.

COGCC response:

Most oil and gas wells in Colorado reach depths that provide thousands of feet of separation between the hydrocarbon zones and aquifers. Based on this separation and the intervening shale zones, it is unlikely that natural or hydraulic fractures would extend from a hydrocarbon zone to an aquifer. Offsetting wells are similarly unlikely to serve as conduits for hydraulic fracturing fluid migration given the relative fracture lengths and well distances. Therefore, the potential for fluid migration from deep zones along fractures or through offsetting wells is considered low.

For shallow CBM wells, special requirements address the risks associated with potential fluid migration conduits. Under Rule 608, operators seeking to drill such wells must identify all plugged and abandoned (P&A) wells within one-quarter mile and assess the risks of leaking gas or water. If an adjacent P&A well does not adequately isolate the coal formation, then the operator may be required to perform remedial activity to mitigate the potential risks. The operator must also: survey the P&A wells for soil gases before and after production begins;

sample water wells before and after drilling the CMB well; and survey coal outcrops or coal mines within two miles to identify any gas seeps or springs. Special static bottom-hole and bradenhead pressure tests must be conducted under certain circumstances.

The potential for fluids to migrate up the newly drilled well due to poorly cemented production casing is addressed by the regulations and policies described above in response to Question 3.

The COGCC also has an extensive ground and surface water monitoring program to determine whether impacts from oil and gas operations, including hydraulic fracturing, have occurred. Various Commission orders (Causes 112-138, 112-156, 112-157, and approximately 20 others) require San Juan Basin operators to collect water well samples; these samples must be collected before a proposed coalbed methane well is drilled, and then again one, three, and six years after completion. Rule 608 effectively extends these requirements to coalbed methane wells in other parts of the state. Rule 317B requires operators in surface water supply areas to collect surface water samples, and Rule 318A.e.(4) requires Greater Wattenberg Basin operators to conduct baseline sampling for certain infill or boundary wells. The COGCC and operators are also working on a sampling plan for areas where horizontal wells are being drilled. In addition, the COGCC conducts ground water studies throughout the state and samples individual water wells in response to landowner complaints and requests. As a result of this work, the COGCC database currently contains sampling results for more than 5,000 water wells and approximately 6,500 oil and gas wells.

*5. Describe program requirements that address actions to be taken in **response to unanticipated operational or mechanical changes** encountered during hydraulic fracturing that may cause concern.*

COGCC response:

Rule 341 requires operators to continuously monitor and record the bradenhead annular pressure during hydraulic fracturing and to notify the COGCC as soon as practicable if the pressure increases more than 200 psig. This provides prompt notice to the operator and the COGCC of circumstances indicating that fracturing fluids may have escaped the producing reservoir. Other relevant regulations include: Rule 327, which requires operators to report loss of well control as soon as practicable, but in not less than 24 hours; and Rule 906, which requires operators to control and contain all spills and releases of exploration and production (E&P) waste immediately upon discovery and to notify the COGCC if such spills and releases exceed five barrels or impact or threaten to impact any water, residence, livestock, or byway.

*6. Briefly describe how **surface controls** associated with hydraulic fracturing, such as dikes, pits, or tanks, meet Sections 5.5 and 5.9 of the guidelines.*

COGCC response:

A number of regulations ensure that surface controls such as dikes, pits, and tanks protect the environment. These regulations address facility siting (Rule 303), tanks (Rules 603 and 604), pits (Rules 902-905), spill prevention and response (Rule 906), stormwater management (Rule 1002.f), and reclamation (Rules 1003 and 1004).

The siting of oil and gas locations, which include well pads, pits, and other surface-disturbing activities, is governed by Rule 303.d. It requires operators to submit an Oil & Gas Location Assessment (Form 2A) for COGCC review. Protection of surface and groundwater resources is one of the primary objectives of this review, and special conditions of approval (COAs) and best management practices (BMPs) are required where appropriate. Under Rule 317B, special

requirements apply to operations in surface water supply areas, including special setback requirements as well as additional requirements regarding equipment, secondary containment, baseline sampling, notice, and emergency planning. Rules 603, 604, and 805 set forth additional setback requirements for certain types of equipment and areas.

The safety regulations (600 Series Rules) address tank construction, operation, and secondary containment. For example, Rule 604.a requires tanks to comply with a series of industry standards for construction, design and maintenance. It also imposes siting, operating, labeling, and secondary containment requirements. Under Rule 603.e, tanks in high density areas are subject to additional requirements, including more stringent obligations regarding secondary containment and compliance with the National Fire Prevention Association Flammable and Combustible Liquids Code-30.

The E&P waste management regulations (900 Series Rules) address pits. These regulations impose operating standards (Rule 902), permitting requirements (Rule 903), lining specifications (Rule 904) and closure obligations (Rule 905). Rule 902.b requires operators to maintain two feet of freeboard and to measure and monitor fluid levels. The pit permit application (Form 15) gathers information on the construction details, type of pit, and location. Pit permitting also requires an Oil and Gas Location Assessment (Form 2A), which provides additional information on soils, vegetation, land use, wildlife, and hydrology. Under Rule 906.e, secondary containment must be sufficiently impervious to contain any discharges. Under Rule 908, special permitting, operating, and disclosure requirements apply to centralized E&P waste management facilities, which typically include the largest pits.

Spill prevention and control is addressed in Rule 906, which is discussed below in response to Question 7.

Rule 1002.f imposes stormwater management requirements that cover all phases of oil and gas operations. The stormwater rules include requirements for implementation of BMPs to prevent erosion by water and wind and degradation due to chemical impacts. These BMPs include material covering, material handling, spill prevention, self inspection, periodic maintenance and good housekeeping procedures. Rules 1003 and 1004 govern interim and final reclamation, and they impose specific requirements for pit reclamation.

*7. Briefly describe how **contingency planning and spill risk management** procedures related to hydraulic fracturing meet Section 4.2.1 of the guidelines*

COGCC response:

The COGCC has a multi-faceted program for contingency planning and spill risk management. This program includes rules for release reporting and remediation, mechanisms for operators and the public to report spills, and interagency agreements.

Rule 324A.a requires operators take precautions to prevent significant adverse impacts to air, water or biological resources. Rule 906 governs E&P spills and releases, and it sets forth specific reporting thresholds, deadlines, and formats. Rule 906.a requires that all spills and releases of E&P waste be controlled and contained immediately upon discovery and investigated and cleaned up as soon as practicable. Spills and releases greater than 5 barrels or that impact or threaten to impact state waters must be reported to the COGCC. A 24-hour, toll-free, telephone number is available on the COGCC website for operators or the public to report incidents. For all reportable spills, operators must submit a Spill/Release Report (Form 19). The Form 19 is entered into the COGCC database and can be queried by staff and the public. Violation of these reporting requirements will result in the issuance of a Notice of

Alleged Violation (NOAV), which may lead to a fine. Under Rule 906.d, COGCC staff can require the operator to submit a Site Investigation and Remediation Work Plan (Form 27). Forms 27s are reviewed by COGCC environmental staff and tracked in the COGCC database. The COGCC receives an annual appropriation for emergency response, which is used to investigate, prevent, monitor and mitigate significant adverse environmental impacts.

Contingency planning and spill risk management are also furthered by the Oil and Gas Location Assessment (Form 2A) review process, which is described above in response to Question 6. Through that process, site-specific environmental information is evaluated by environmental professionals. These professionals work with the operator to ensure that the site is developed and operated in a manner that protects the environment.

In addition, special emergency response and contingency plans are required for operations in surface water supply areas under Rule 317B and for centralized E&P waste management facilities under Rule 908. The COGCC also requires reports for accidents that cause excessive damage to equipment or the well site (Rule 602.b) and for loss of well control (Rule 327). The latter reports are reviewed by the area engineer, and the environmental and inspection units are notified as necessary to assess potential environmental impacts.

In addition to the COGCC, the Colorado Department of Public Health and Environment (CDPHE) maintains a 24-hour Environmental Release/Incident Report Hotline and a process for tracking spill and release information. The COGCC has entered into a Memorandum of Agreement with the CDPHE Water Quality Control Division (WQCD) regarding the state's response to spills and releases from oil and gas facilities.

*8. Briefly discuss how hydraulic fracturing **waste characterization requirements**, including, as appropriate, testing of fracturing fluids, are consistent with Section 5.2 of the guidelines.*

To ensure that E&P management practices are suited to the particular wastes involved and comply with applicable program requirements, the COGCC requires that operators characterize the waste using procedures outlined in the 900 Series Rules. Analytical parameters must be based on site-specific conditions and process knowledge, and they must be approved by the COGCC. If there is any doubt about what a waste contains or if there is reason to believe that an unidentified substance has been released, then an exhaustive list of analytical parameters, such as complete EPA Method 8260 and Method 8270 as well as the COGCC Table 910-1 list, gas composition, and stable isotopes, can be identified and analyzed.

In addition to the COGCC's own knowledge of substances used by oil and gas operators, the COGCC also requires operators to provide specific information that is used to characterize waste, identify appropriate treatment and disposal methods, and ensure that remediation is complete and satisfies the Table 910-1 concentrations. Operators are also required to maintain specific information on chemicals and waste. Under Rule 205, operators must maintain Material Safety Data Sheets (MSDSs) for and an inventory of the chemical products used downhole, including hydraulic fracturing fluids. Under Rule 907.b.(2), operators must maintain records documenting the type and volume of waste transported off site, including fracturing flowback and produced water. These requirements are further described below in response to Questions 10 and 15.

If hydraulic fracturing waste is spilled or released, it must be reported to the COGCC in accordance with Rule 906.b. and remediated in accordance with COGCC Rule 906.d. If ground water is impacted, then operators must also monitor and remediate the impacts until the standards and classifications set by the CDPHE Water Quality Control Commission (WQCC)

are met. The requirements for conducting site investigation, remediation, and closure of facilities are addressed in Rule 909. Remediation must ensure that the concentration levels in Table 910-1 are met. The Table 910-1 concentration levels for soils and other solids are adapted from the CDPHE's Hazardous Materials and Waste Management Division's *Table 1 Colorado Soil Evaluation Values (CSEV) – December 2007* and are intended to protect all future uses of impacted land, including residential uses.

In addition, Rule 910.b.(2) requires that sampling and analysis for site investigation or confirmation of successful remediation be conducted to determine the nature and extent of impact and confirm compliance with the Table 910-1 concentration levels. This regulation includes requirements for field and laboratory analyses and sample collections, including background sampling.

COGCC response:

*9. Briefly describe how the **waste management hierarchy** contained in Section 5.3 of the guidelines (source reduction, recycling, treatment, and disposal), including the provisions relating to toxicity reduction, are promoted for hydraulic fracturing.*

Rule 907 provides general requirements to ensure that E&P waste is properly stored, handled, transported, treated, recycled, and disposed. Operators are encouraged to: reduce the quantity and toxicity of their waste; recycle, reuse and reclaim it; treat it to reduce toxicity; and dispose of it in a manner that protects the environment. Several of the 900 Series Rules require simple practices for reducing waste toxicity and volume, including: removing oil and condensate before produced water is placed in a production pit (Rule 907.c) and subsequent removal of any accumulation within 24 hours (Rule 902.c); monitoring freeboard in all pits, including those used for flowback, to ensure spills and releases do not occur (Rule 902.b); and constructing secondary containment around tanks, including tanks containing water with a TDS greater than 3,500 mg/l, that is sufficiently impervious to contain spills and releases (Rule 906.e).

In addition, the Oil and Gas Location Assessment process (Rule 303.d.) encourages operators to plan new oil and gas locations with appropriate BMPs to control stormwater. This should help reduce the quantity of contaminated stormwater that is generated as waste, including stormwater that comes in contact with hydraulic fracturing waste. BMPs commonly employed include tertiary containment, site perimeter berms, diversion ditches, site grading, and catchment basins.

The COGCC and several operators are currently working on finalizing waste sharing plans. These plans will allow produced water and flowback fluids from one operator's wells to be reused and recycled by another operator. This should help reduce both the volumes of fresh water used for drilling, completion, and workover and the volumes of waste generated. The COGCC anticipates that more operators will undertake similar plans in the future in certain areas of the state. In addition to promoting waste minimization, reuse, and recycling, these plans should also shorten truck hauling distances and reduce truck traffic; this, in turn, should decrease truck exhaust emissions, dust, noise, accidents and spills, and increase operating efficiencies.

*10. Briefly describe how the **tracking of hydraulic fracturing waste** disposed at commercial or centralized facilities meets the requirements of Section 5.10.2.3 of the guidelines.*

COGCC response:

Rule 907.b.(2) requires that for E&P waste, including hydraulic fracturing waste, transported off-site, the waste generator must maintain copies of each invoice, bill, ticket, or other record that documents the date of transport, the identity of the waste generator and transporter, the location of the pick-up site, the type and volume of waste, and the name and location of the disposal site. These records must be made available for inspection and copies provided to the COGCC upon request.

Rule 908 imposes additional requirements for centralized E&P waste management facilities. It requires that such facilities be designed to control public access, prevent unauthorized traffic, provide security and prevent illegal dumping. As part of the permitting process, operators must estimate the types, character, and amounts of wastes that will be received. Operator also must submit an annual report to the COGCC, which specifies the types and volumes of waste actually handled. At final closure, operators must dispose or treat residual waste, collect samples to verify compliance with soil and ground water standards, implement post-closure monitoring, and complete other remediation, as required.

In addition, operators must report to the COGCC on a monthly basis (Form 7) the volumes of hydraulic fracturing waste disposed of down a Class II Underground Injection Control (UIC) well. This reporting requirement applies regardless of whether the waste is trucked or piped to a UIC well.

The COGCC does not permit or regulate waste haulers; however, COGCC rules require that the oil and gas operators ensure that E&P waste is properly managed to prevent significant adverse environmental impacts and ensure compliance with soil and ground water standards. If a spill or release of E&P waste occurs during transportation, the operator must report to the COGCC and remediate any impacts (Rule 906).

*11. Briefly describe how procedures in place for receipt of **complaints** related to hydraulic fracturing are consistent with Section 4.1.2.1.*

COGCC response:

It is COGCC policy to respond to all complaints within 48 hours and the COGCC strives to do so within 24 hours. Complaint information is gathered on a Form 18, which is entered into the database by location or facility. Each complaint is analyzed and assigned to a member of the COGCC's environmental, engineering, or inspection staff. Complaints are investigated through site inspections, data collection, field review and sampling and analysis. After the initial inspection and any data collection, an assessment is completed to determine if additional work is required. Photographs, maps and other documents are entered into the database and indexed to the complaint. When the complaint is resolved or closed, a report is generated. Throughout the investigation, the database is available to the staff and public, and database queries have been developed to facilitate information retrieval.

Based on its investigation, the COGCC staff may issue an NOAV to the operator that includes abatement actions and a completion schedule (Rule 522). The mineral owner, surface owner, other state agencies or local government may request that the COGCC issue a violation. If the complainant disagrees with a staff decision not to pursue enforcement, he or she can apply to the Commission for an Order of Finding Violation.

The COGCC also has a well developed field inspection process that includes routine and systematic inspections of oil and gas facilities and locations. The Inspection Unit is comprised of 15 staff located in remote offices throughout the state. In 2010, the unit conducted more than

17,000 inspections, most of which were unannounced. Under Rule 204, the COGCC can inspect oil and gas properties, disposal facilities, and wells. Under Rule 205, the COGCC can require operators to provide records, books, and other documentation, and under Rule 207 the COGCC can require operators to conduct tests and surveys.

### **Reporting Associated with Hydraulic Fracturing [9.2.2]**

*12. Describe any required **notification** prior to, and reporting after completion of, hydraulic fracturing operations.*

#### COGCC response:

The COGCC requires various notices and reports before and after a well is hydraulically fractured. As a COA on all APDs, the contact information for the assigned area inspector is placed on the permit with a requirement to contact the area inspector 24 hours prior to spudding the well.

The Northwest Colorado Notification Policy requires that operators completing wells in Northwest Colorado submit prior notice of commencement of completion operations via email to COGCC's field inspector and field inspection supervisor. The notice is attached as a COA on all APDs in Chaffee, Delta, Eagle, Garfield, Grand, Gunnison, Jackson, Lake, Mesa, Moffat, Montrose (north of the 48N/49N township line), Routt, Pitkin, Rio Blanco, and Summit Counties.

Under Rule 341, the COGCC must be promptly notified of significant increases in the bradenhead pressure during hydraulic fracturing. Within 15 days after such an occurrence, the operator must submit a sundry notice (Form 4), giving the details and corrective actions taken. Under Rule 308B, operators must report the formation treatment on a Completed Interval Report (Form 5A) within 30 days of the completion.

Special notices are required if a serious event occurs resulting in an spill, accident, or loss of well control. A spill or release of fluids requires notice under Rules 337, 905.c, and 906 (Form 19). An accident requires notice under Rule 602.b (Form 22). A loss of well control requires notice under Rule 327 (Form 23).

*13. Is notification sufficient to allow for the **presence of field staff** to monitor hydraulic fracturing activities?*

#### COGCC response:

The COGCC conducts inspections during and after drilling, construction and production to verify that all project work performed by the operator complies with the proper regulations and permits. The COGCC performed over 17,000 inspections 2010.

Notification concerning hydraulic fracturing can be included as a COA on an APD or Location Assessment or through procedures specific to certain areas as discussed in the response to Question 12. The notification requirements include specific time frames and contact information for operators to follow in providing notice. This process provides sufficient time for field staff to arrange the monitoring of hydraulic fracturing operations. Field inspection staff are also assigned to specific areas and are tasked with knowing rig locations and rig crews and have individualized inspection goals and priorities. Field staff are therefore routinely in the field conducting inspections and working with oil and gas operators, who provide schedules of planned operations such as hydraulic fracturing and flow back.

14. Describe **reporting requirements** for hydraulic fracturing activities and whether they include the identification of materials used, aggregate volumes of fracturing fluids and proppant used, and fracture pressures recorded.

COGCC response:

Rule 308B requires operators to file a Completed Interval Report (Form 5A) within thirty days after completing or re-stimulating a formation. The Report includes a field for summarizing the formation treatment, and operators often include information on the identity and volume of the fluids and proppants. The COGCC has also encouraged Colorado operators to provide information on hydraulic fracturing fluid constituents and volumes through the FracFocus website. To date, at least 21 Colorado operators have registered to participate in the website, and these operators accounted for approximately 83 % of the wells drilled in Colorado during the first quarter of 2011.

15. Describe any mechanisms for **disclosure of information on chemical constituents** used in hydraulic fracturing fluids to the state in the event of an investigation or to medical personnel in the event of a medical emergency.

COGCC response:

Rule 205 requires operators to maintain an inventory by well site for each chemical product used downhole or stored for use downhole in an amount exceeding 500 pounds during a quarter, including hydraulic fracturing fluids. Operators must also maintain MSDSs for all chemical products brought to the wellsite for use downhole. MSDSs and chemical inventory information, including the chemical constituents of the product, must be provided to the COGCC within three business days of request or as soon as possible in a medical emergency.

If the composition of the chemical product is a trade secret, then Rule 205 requires the vendor or service operator to provide the COGCC with the chemical constituent information upon receipt of a letter stating that such information is needed for the COGCC to respond to a spill, release, or complaint. The COGCC, in turn, may share this information with its Commissioners, the County Public Health Director or Emergency Manager, and the CDPHE.

Rule 205 also requires the vendor or service operator to provide chemical constituent information to any health professional who submits a written statement of need for the information and executes a confidentiality agreement (Form 35). Where the health professional determines that a medical emergency exists and the information is necessary for emergency treatment, the information must be provided immediately based upon the professional's verbal acknowledgement of need and confidentiality. In such event, the health professional can subsequently submit a written statement of need and a confidentiality agreement when circumstances permit.

16. Briefly describe how hydraulic fracturing information submitted that is of a **confidential business nature**, is treated consistent with Section 4.2.2 of the guidelines?

COGCC response:

Rule 205 provides special protection for hydraulic fracturing information that is of a confidential business nature. Where the vendor or service provider considers the chemical composition to be a trade secret, operators are not required to maintain information on the product constituents; instead, the vendor or service company is responsible for providing such information to the COGCC.

All such information is considered confidential, does not become part of the chemical inventory, and is not construed as publicly available. The COGCC may share it internally only as needed in responding to the spill, release, or complaint, and the recipients may not disseminate the information further. The same terms and conditions regarding use and confidentiality apply if the COGCC shares the information with its Commissioners, the County Public Health Director or Emergency Manager, or the CDPHE. Similarly, any health professional who obtains the information must provide a written statement of need and execute a confidentiality agreement.

Further restrictions apply if the information is entitled to protection as a trade secret under the Colorado Open Records Act, C.R.S. § 24-72-204, or other state or federal law. In such event, the information may be disclosed only to legally authorized persons and must be maintained by the recipient as confidential. In addition, the COGCC must provide the service company or vendor with at least one business day's prior notice of the intended disclosure.

### **Staffing and Training [9.2.3]**

*17. Briefly discuss if, in addition to the personnel and funding recommendations found in Section 4.3 of the guidelines, **state staffing levels** sufficient to receive, record and respond to complaints of human health impacts and environmental damage resulting from hydraulic fracturing.*

#### COGCC response:

The COGCC is funded by Conservation Mil Levy and Severance Tax monies, both of which are based on production sales values. While the agency is considered cash funded by these monies, the agency budget is controlled by spending authority proposed in the Governor's budget request and then authorized by the legislature. For the current fiscal year (July 2010 through June 2011), the COGCC has 69 full time staff and a budget of approximately \$8.5 million.

The COGCC has increased its staffing levels over the last several years, primarily in the areas of permitting and field inspection. The last increase in personnel in these areas included environmental protection specialists to evaluate Location Assessments and specialized field inspectors to address reclamation issues. There was also an increase in the environmental group providing another person in Northwest Colorado to focus on environmental impacts and remediation.

The COGCC has always placed the highest priority on responding to environmental complaints. As discussed above in response to Question 11, the COGCC's policy is to respond to all complainants within 48 hours and often does so within 24 hours. All complaints are also memorialized and incorporated into the COGCC database. Using this database, complainants can monitor the investigation and resolution of their complaints.

The COGCC's focus on complaint response is illustrated by the COGCC's recent investigation of a complaint alleging impacts to a water well in Southeastern Colorado from hydraulic fracturing. The complaint was emailed to the COGCC late in the afternoon of June 30, 2010. A COGCC environmental protection specialist was on site the next morning to collect well water and flowback samples. He returned to collect additional water, sediment, and rock samples on July 8 and 14, obtained the fracturing fluid constituents from the vendor, and arranged for a variety of laboratory analyses. Following more than 40 hours of work, including consulting with other environmental and engineering staff, he concluded that the water well had not been impacted by hydraulic fracturing. His conclusions were memorialized in a 29-page letter, which was sent to the complainants on December 1, 2010. When the complainants were dissatisfied

with these conclusions, they received a formal hearing before the Commission in February 2011.

18. Describe staff **training** to stay current with new and developing hydraulic fracturing technology.

COGCC response:

In an effort to keep current with new and developing hydraulic fracturing technology, members of the COGCC staff have taken university level courses, attended industry classes, and spoken with service companies. Courses at the Colorado School of Mines have included sections on hydraulic fracturing methods. Shorter industry classes have been taken through the Petroleum Technology Transfer Council (PTTC). Recent PTTC classes have included:

- Hydraulic Fracturing: Measurement, Characterization, and Analysis;
- Completion & Stimulation(s) of Horizontal Wells in Tight and Unconventional Gas Reservoirs;
- Completions and Stimulation for Geologists; and
- Reservoir Geomechanics Applied to Unconventional Resources.

Industry experts have also provided training classes to staff on hydraulic fracturing. Schlumberger, Baker Hughes, BJ Services, and Halliburton have recently provided such training on the following topics:

- Cased Hole Logging - Ultrasonic Imaging, Reservoir Saturation Tool and Isolation Scanner of Gas Migration and Fracture Detection;
- Micro-Seismic Monitoring of Hydraulic Fracturing;
- “Frac 101”- General Hydraulic Fracture Overview of Operations and Methods;
- “Frac 301”- Detailed Discussion of Hydraulic Fracturing Fluids and Applications;
- Horizontal Drilling and Rotary Steerable Drilling;
- Formation Evaluation;
- Fracture Modeling;
- Cement Bond Logs;
- Cement Chemistry; and
- Foam and Thixotropic Cements.

In addition, two major Colorado operators, Anadarko and EnCana, have presented information on their hydraulic fracturing and horizontal drilling operations and procedures.

Finally, the COGCC holds internal operations meetings twice a year, which are attended by all engineering, inspection, and environmental staff. These meetings provide an additional opportunity to share information on hydraulic fracturing developments.

**Public Information [9.2.4]**

19. Briefly describe how the state agency provides for **dissemination of educational information** regarding well construction and hydraulic fracturing to bridge the knowledge gap between experts and the public as provided in Section 4.2.2.2 of the guidelines. This is especially important in areas where development has not occurred historically and in areas where high volume water use for hydraulic fracturing is occurring.

COGCC response:

The COGCC managers, supervisors, and field staff regularly participate in town hall and local government meetings around the state to provide information on oil and gas development generally and well construction and hydraulic fracturing specifically. Many of these meetings occur in areas where little or no development has occurred historically. During the past six months, the COGCC has convened or participated in such meetings in Douglas County, Elbert County, El Paso County, Fremont County, Garfield County, Gunnison County, Huerfano County, La Plata County, Mesa County, Montezuma County, Park County, Rio Grande County, and Weld County. The COGCC also recently participated in meetings on this subject conducted by the Bureau of Land Management and the Colorado Association of County Attorneys, and the COGCC plans to work with local governmental organizations to organize and present workshops for local government officials later this year.

In addition to providing educational information through public meetings, the COGCC also uses its website, [www.colorado.gov/cogcc](http://www.colorado.gov/cogcc), to disseminate such information. On the website, visitors can access: information on current events; COGCC rules, policies, and forms; environmental, inspection, and production data; information on specific wells and pending applications; and various other types of data. During 2010, the website received over 1.1 million visits, indicating that it is a popular source of information. To make information about hydraulic fracturing more prominent, the COGCC has recently added a special hydraulic fracturing webpage. This webpage includes links to information on well construction and hydraulic fracturing practices, COGCC regulations, frequently asked questions, and other relevant documents, such as the COGCC's Gasland Correction Document, power point presentations, and correspondence with other agencies. It also provides links to the FracFocus, EPA, and BLM websites as well as other websites with information on this subject.

**Water and Waste Management Associated with Hydraulic Fracturing [9.3]**

*20. Fundamental differences exist from state to state, and between regions within a state, in terms of geology and hydrology. Describe how the state evaluated and addressed, where necessary, the **availability of water for hydraulic fracturing** in the context of all competing uses and potential environmental impacts resulting from the volume of water used for hydraulic fracturing.*

COGCC response:

The DWR oversees the administration of both surface and ground water, including water produced by and used in oil and gas activities. Water that is used for hydraulic fracturing must come from a legal source. The water can be purchased or leased from a municipality, just as other industries do. An agricultural water right can be temporarily changed to industrial use so that an operator can lease or purchase water from a rancher or farmer. Water that is "fully consumed" such as treated waste water from a municipality can be leased or purchased, or Denver Basin "non-tributary" water can be purchased from the landowner. Operators can use produced water; however, such water must either be "non-tributary," or if it is decreed tributary, then the operator must have an augmentation plan. A recent ruling in Colorado District 7 Water Court may result in changes to the requirements for operators to use and produce non-tributary water.

As explained above in response to Question 4, the COGCC also has an extensive ground and surface water monitoring program to determine whether water quality impacts have occurred.

21. Describe how the availability and use of **alternative water sources** for hydraulic fracturing, including recycled water, is encouraged.

COGCC response:

COGCC regulations encourage and promote reuse and recycling of E&P waste for all purposes, including hydraulic fracturing. Rule 907.a.(3) encourages operators to submit waste management plans for COGCC approval, and such plans may provide for the recycling and reuse of waste water for hydraulic fracturing. Rules 902.e and 903.a.(4) create a new pit classification for multiwell pits, which is likewise intended to encourage the reuse and recycling of waste water for hydraulic fracturing and other purposes. These pits are often centrally located in the oil or gas field, are used to store fluids from multiple wells, and may include treatment areas where fracturing flow-back fluids and produced water can be brought up to specifications. As explained above in response to Question 9, the COGCC is also working with several operators on waste sharing plans that will facilitate the reuse and recycling of fracturing fluids and produced water.

22. Briefly describe how **waste** associated with hydraulic fracturing is managed consistent with Section 4.1.1 and Section 7 of the guidelines.

COGCC response:

The 900 Series Rules address the management of E&P waste, including hydraulic fracturing waste. These regulations help ensure that such waste does not cause significant adverse environmental impacts and protects public health, safety, and welfare.

Under Rule 903, individual permits (Form 15) are issued for production pits, special purpose pits, drilling pits when oil or salt based drilling fluids are used, and multi-well pits that are for recycling produced water, drilling fluids, or completion fluids, including hydraulic fracturing flowback fluids. Although the individual pit permits do not have a fixed term, they can be revoked if the facility is not operated in accordance with COGCC regulations and permit requirements. When water based bentonitic drilling fluids, foam, or other non-oil or salt based drilling fluids are used, drilling pits are authorized by Rule 903, not by individual permit. These drilling pits can be used to contain fluids and solids produced during initial completion procedures, which includes flowback from hydraulic fracturing; however, drilling pits, like other kinds of pits, must be constructed and operated to protect state waters. Drilling pits that are “repurposed,” that is, used for some other purpose after drilling activities are completed, such as produced water storage, must be permitted for the new activity in accordance with Rule 903. Under Rule 1003.d, drilling pits that are not “repurposed” and permitted must be closed within 3 months after drilling and completion activities conclude. The drilling fluids must be removed from the pit and the remaining contents must be dry and meet Table 910-1 concentration levels before the pit is backfilled and reclaimed.

Under Rule 908, centralized E&P waste management facilities are also individually permitted (Form 28) and bonded. This permitting process is more extensive and requires information on the site geology and hydrology, waste profile, facility design, operating plan, and contingency plan. Ground water monitoring is required, and operators must submit an annual report to the COGCC to ensure compliance with the permit regulations.

In addition to the individual permits (Forms 15 and 28), operators must submit an Oil and Gas Location Assessment (Form 2A) for all surface disturbance at previously undisturbed sites or for expanding an existing location; this includes constructing a drilling or production pit and multi-

well tank batteries. The Location Assessment process is described above in response to Questions 6, 7, and 9.

Data regarding naturally occurring radioactive waste (NORM) is limited. In general, elevated concentrations of NORM have not been considered a problem in E&P wastes, including hydraulic fracturing wastes, produced from oil and gas wells in Colorado.

*23. Discuss how the state encourages the efficient development of adequate **capacity and infrastructure** for the management of hydraulic fracturing fluids, including the transportation, recycling, treatment, and disposal of source water and hydraulic fracturing wastes.*

COGCC response:

Colorado gas production has increased from 500 billion cubic feet in 1990 to 1.5 trillion cubic feet in 2008. The majority of this increase can be attributed to tight gas sands production that would not have occurred without improvements to fracture stimulation technology, primarily through increases to the volume and size of the fracture stimulations. Large fracture treatments are prevalent in the Wattenberg Field in Northern Colorado, as well as the Piceance Basin in Northwest Colorado.

Water is a precious commodity in Colorado and the state's mountainous terrain can make fluid transportation a difficult and expensive operation. In recent years, approximately 60 to 70% of the wells permitted were for multiwell pads, where 8 to 20 or more wells would be sited. Under these circumstances, operators have increasingly developed centralized stimulation and water handling facilities, which support multiple well pads and facilitate the reuse and recycling of water for hydraulic fracturing and other purposes. As explained above in response to Questions 9 and 21, the COGCC has encouraged the development of such facilities and arrangements under Rules 903 and 907.

The predominant method of water disposal in Colorado is injection into UIC wells under Rule 325. Colorado currently has 290 Class II UIC wells used for disposal, and the number of these wells is steadily increasing. They receive about 60% of the water that is currently produced by the oil and gas industry. The remainder of the water either evaporates or is discharged into surface waters pursuant to permits issued by the WQCD. Evaporation is a common disposal method in the Piceance Basin, while surface discharges are common in the Raton Basin, where coalbed methane is produced, water production is significant, and the water meets or can be treated to meet surface discharge standards.





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