



June 24, 2013

Project No. 134911

Mr. Bill Heard
Chama Oil & Minerals, LLC
10 Desta Drive, Suite 260-E
Midland, Texas 79705

Subject: H₂S Contingency Plan
Heart 22-15-48 #1H
Cheyenne County, Colorado

Mr. Heard:

Please find enclosed one electronic copy of the H₂S Contingency Plan for the Heart 22-15-48 #1H in Cheyenne County, Colorado.

We appreciate the opportunity to provide this service to Chama Oil & Minerals, LLC. Should you require additional information, have any questions regarding this report, or wish to discuss the recommendations provided, please contact me at (303) 781-8211.

Respectfully submitted,

KLEINFELDER WEST, INC.

A handwritten signature in black ink, appearing to read "Brad Baum", is written over a light blue horizontal line.

Bradley M. Baum, M.S.
Project Manager I/Regulatory Specialist

Attachment

**H₂S CONTINGENCY PLAN
HEART 22-15-48 #1H
CHEYENNE COUNTY, COLORADO**

JUNE 24, 2013

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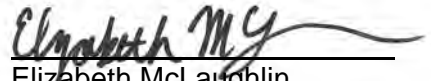
A Report Prepared for:

Mr. Bill Heard
Chama Oil & Minerals, LLC
10 Desta Drive, Suite 260-E
Midland, Texas 79705

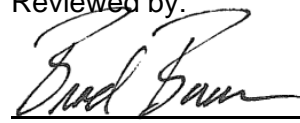
H₂S Contingency Plan
Heart 22-15-48 #1H
Cheyenne County, Colorado

Kleinfelder Job No. 134911

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1.0 INTRODUCTION

This Hydrogen Sulfide (H₂S) Contingency Plan was prepared for Chama Oil & Minerals, LLC (Chama) using components from the American Petroleum Institute (API) Recommended Practice No. 55 and the Bureau of Land Management (BLM) Onshore Order #6. The plan is to be implemented at facilities or drilling sites where H₂S concentrations of 10 parts per million (ppm) or higher may be encountered or where an accidental release of hydrogen sulfide may occur. In order for the plan to be effective, all personnel must review and be familiar with their responsibilities as well as the safety equipment involved.

1.1 WELL LOCATION

Heart 22-15-48 #1H

NE/NE Section 22, Township 15 South, Range 48 West, 6th Prime Meridian

Cheyenne County, Colorado

Latitude: 38.733772, Longitude: -102.760342

A figure showing the general location of the well pad is provided as Figure 1-1.

1.2 NAME AND ADDRESS OF THE OPERATOR

Chama Oil & Minerals, LLC

10 Desta Drive, Suite 260-E

Midland, Texas 79705

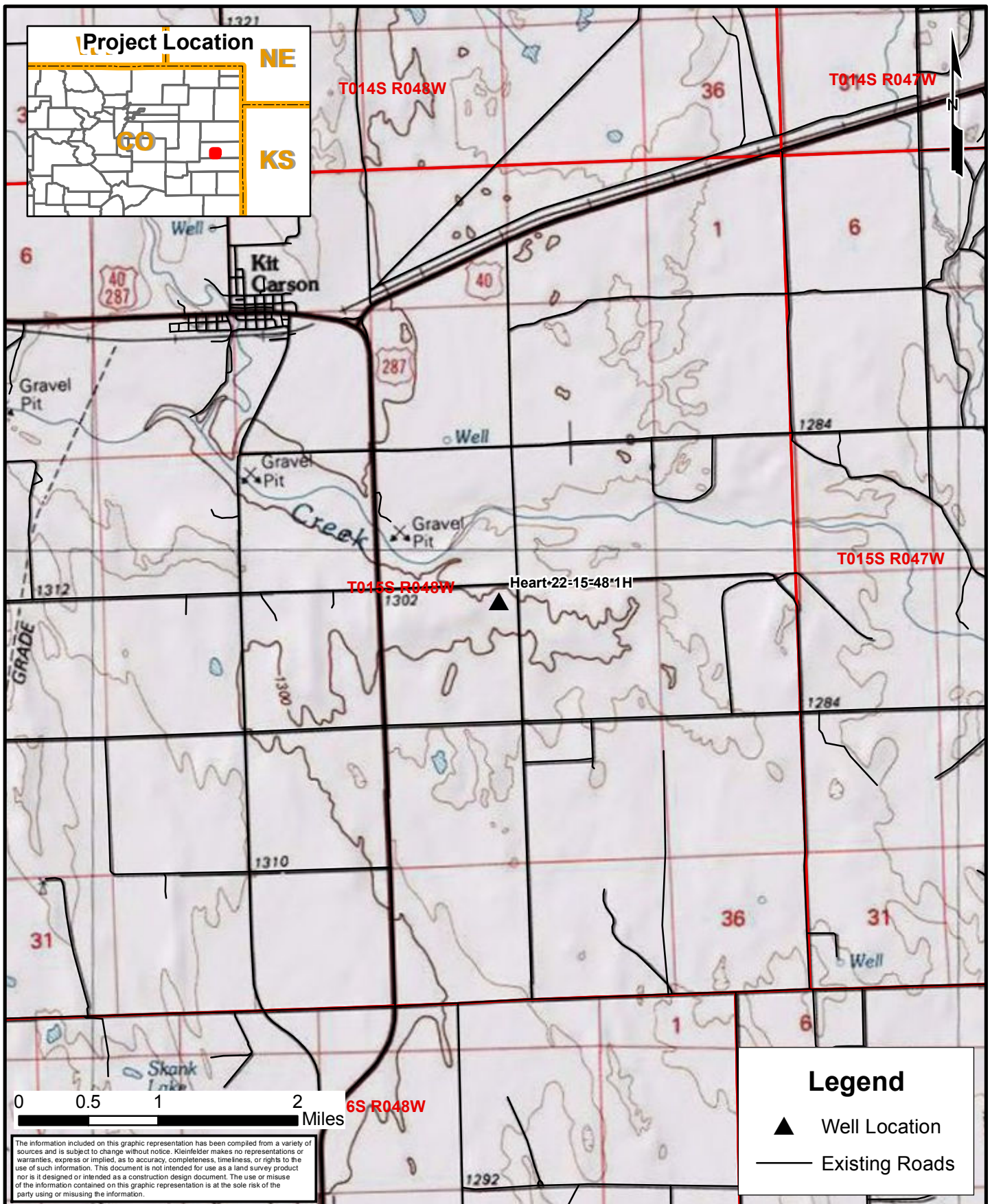
A copy of this Contingency Plan is on file at the address listed above and with the onsite Chama Area Representative.

1.3 HYDROGEN SULFIDE

According to the Occupational Safety and Health Administration (OSHA), hydrogen sulfide, or sour gas, is a flammable, colorless gas that is toxic at extremely low concentrations (e.g., 100 parts per million or ppm). It is heavier than air, and may accumulate in low-lying areas. It smells like "rotten eggs" at low concentrations and causes you to quickly lose your sense of smell. Many areas where the gas is found have been identified, but pockets of the gas can occur anywhere.

Sulfur dioxide (SO₂) is a toxic gas produced by the burning or flaring of H₂S. Inhaling SO₂ can lead to respiratory symptoms and disease, difficulty breathing, and premature death.

The properties of H₂S and SO₂ are discussed further in **Section 8.0**.



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CHECKED BY:	E. McLaughlin
FILE NAME:	ProjectLocation.mxd

Chama Oil & Minerals, LLC

Heart 22-15-48 #1H
Project Location
Cheyenne County, Colorado

FIGURE

1-1

1.4 DEFINITIONS

Breathing zone - OSHA defines the breathing zone as the area “within a 10-inch radius of the worker’s nose and mouth.” That would indicate that an instrument used primarily for personal protection from toxic hazards such as H₂S should be worn on the collar, the lapel, on a breast pocket or even on the brim of a hard hat – or simply within a 10-inch radius of your nose and mouth.

Time Weighted Average (TWA) – the average exposure over a specific period of time, usually a nominal eight hours.

Short Term Exposure Limit (STEL) – the acceptable average exposure over a short period of time, usually 15 minutes as long as the TWA is not exceeded.

Permissible Exposure Limit (PEL) – a legal limit for exposure of an employee to a chemical substance or chemical agent. PELs are established by the Occupational Safety and Health Administration (OSHA).

Immediately Dangerous to Life or Health (IDLH) – defined by the US National Institute for Occupational Safety and Health (NIOSH) as exposure to airborne contaminants that is "likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment."

2.0 REQUIREMENTS AND RESPONSIBILITIES

2.1 PERSONNEL RESPONSIBILITIES

All personnel on site shall:

- Check in with the Chama Area Supervisor immediately prior to entering property and again when exiting property.
- Always be on alert for possible H₂S alarms, both audible and visual.
- Be familiar with location of Safe Briefing Areas (SBA) and protective breathing equipment.
- Develop “wind awareness”. Be aware of prevailing wind direction by noting the location of the windsock and taking periodic observations of the windsock.
- In low or no wind conditions, be aware of the local topography. H₂S can accumulate in low lying areas (e.g., ditches, valleys, etc.).
- Familiarize themselves with the nearest escape route for safe evacuation. Generally, this would be cross wind and then upwind of the suspected H₂S source.
- Should H₂S alarms sound, **DON'T PANIC!** Remain calm, implement evacuation procedures presented during training and follow the instructions of the person in charge.

2.2 CHAMA PERSONNEL

In order to assure proper execution of the H₂S Contingency Plan, it is essential that one person be responsible for and in complete charge of implementing the procedures outlined in this plan. This person should be the Chama Area Supervisor on location. If he/she is unable to perform his/ her duties, these responsibilities shall fall to the Chama Drilling Manager or the next highest person in charge. The succession of responsibilities should be clear to all on the well site.

The Chama representative will:

- Will confirm that all personnel on location are trained in H₂S safety, and
- Will ensure that all safety and emergency procedures are observed by all personnel and contractors.

2.3 PERSONNEL PROTECTION ACTION LEVELS

The minimum measures shall be implemented at each well site including:

1. Personal protective equipment should be provided if the work area exceeds 10 ppm eight hour time weighted average (TWA) or 15 ppm short term exposure level (STEL) averaged over 15 minutes for hydrogen sulfide concentrations.
2. Personal protective equipment should be provided if the work area exceeds 10 ppm eight hour TWA or 5 ppm STEL averaged over 15 minutes for sulfur dioxide concentrations.

3. Where the work atmosphere exceeds the H₂S immediately dangerous to life or health (IDLH) level of 100 ppm, then standby rescue personnel trained in rescue techniques with suitable rescue equipment including 30-minute SCBAs shall be provided (RP 55, Sec 6.5; OSHA 1910.134g(3)).

Please refer to **Section 6.0** for details on Personal Protective Equipment.

2.4 DETECTION EQUIPMENT

The following detection equipment should be located on the well pad:

1. Portable hydrogen sulfide and sulfur dioxide detection instruments.
2. Wind socks should be located in readily visible locations on the site.
3. Stationary H₂S monitoring systems with visible and audible alarms will be located where they can be seen and heard throughout the site. A H₂S monitor should be placed at the mud pit.

All monitoring equipment shall be maintained according to manufacturer's requirements or recommendations.

3.0 EMERGENCY PROCEDURES

Upon discovery of a potential discharge of H₂S gas or if the H₂S alarm sounds (alarms sound at 10 ppm), the following immediate action plan should be initiated.

3.1 IMMEDIATE ACTION PLAN

1. Onsite personnel shall:
 - a. Put on a SCBA unit.
 - b. Immediately evacuate the site along established routes based on wind direction and topography.
 - c. When in a safe briefing area, immediately initiate internal Chama emergency notification process.
 - d. Muster at the safe briefing area and wait there for further instructions from the Chama representative.
 - e. Secure the area using road blocks and flagging tape to prevent non-essential personnel and the public from accessing the site.
2. The designated Chama representative will:
 - a. Assess the situation and advise all personnel by appropriate means of communication.
 - b. Go to safe briefing area and give clear instructions relative to the hazard on location, and actions for personnel to follow.
 - c. Notify company and regulatory groups of the current situation as outlined in company protocol.
 - d. Ensure that essential personnel are properly protected with supplied air breathing equipment and that non-essential personnel are in a "poison gas free" area.
 - e. Account for all personnel.
 - f. Be responsible for authorizing evacuation of persons / residents in the area surrounding the wellsite.
 - g. Initiate rescue protocol, if necessary, by following proper procedures.
 - h. Alert the surrounding public that may be subjected to H₂S concentrations in excess of 30 ppm.
 - i. Contact first available supervisor from call list in Appendix A and notify if additional assistance is needed. Supervisor should notify others from the call list of situation at hand.
 - j. Make recommendations to public officials regarding public evacuations and road blocks. Use the contact list in Appendix A.
 - k. Continue to monitor air on site to determine when the area is safe to enter again.

3. The Chama representative, along with backup personnel, will initiate the following actions:
 - a. Take action to control the H₂S discharge including activating Emergency Shutdown Procedures.
 - b. Remove or shut off all sources of ignition.
 - c. Position fire suppression equipment, if necessary.
 - d. Shut off pumps and close valves that allow gas to flow to the segment of the system from where the release is occurring.
 - e. Repair, plug, or patch the leaking equipment if possible.

4.0 RADIUS OF EXPOSURE DETERMINATION

American Petroleum Institute Recommended Practice Number 55 contains equations for calculating Radius of Exposure (ROE) distances for various key concentration levels. However, these equations are not to be used with low-velocity (less than 200 ft/s) releases of gas as the distances may be under predicted by the equations. The well sites included in this contingency plan contain high-velocity gas flow, so equations from the Bureau of Land Management Onshore Oil and Gas Order Number 6 were used to calculate Radius of Exposure distances.

Onshore Order No. 6 contains calculations used to calculate 100 ppm and 500 ppm radii of exposure. Because Onshore Order No. 6 does not contain an equation for a 10 ppm ROE, a linear regression was performed on the values for the 100 ppm ROE and the 500 ppm using Microsoft Excel. The resultant equation ($y = -0.0888x + 74.175$) was used to calculate a 10 ppm ROE of 73.3 feet.

Equations from the Onshore Order No. 6 are as follows:

$$X_{100} = [1.589 \times H_2S \times Q]^{0.6258}$$

$$X_{500} = [0.4546 \times H_2S \times Q]^{0.6258}$$

Where: X = radius of exposure in feet

H_2S = decimal equivalent of mol fraction of H_2S in gas

 Q = maximum volume of gas determined to be available for escape in cubic feet per day.

Table 4-1. Radius of Exposure Distances Using Onshore Order No. 6

Well Site	H_2S (mol fraction)	Q (cf/day)	500 ppm ROE (ft)	100 ppm ROE (ft)	10 ppm ROE (ft)
Heart 22-15-48 #1H	0.0005	1,000,000	29.8	65.3	73.3

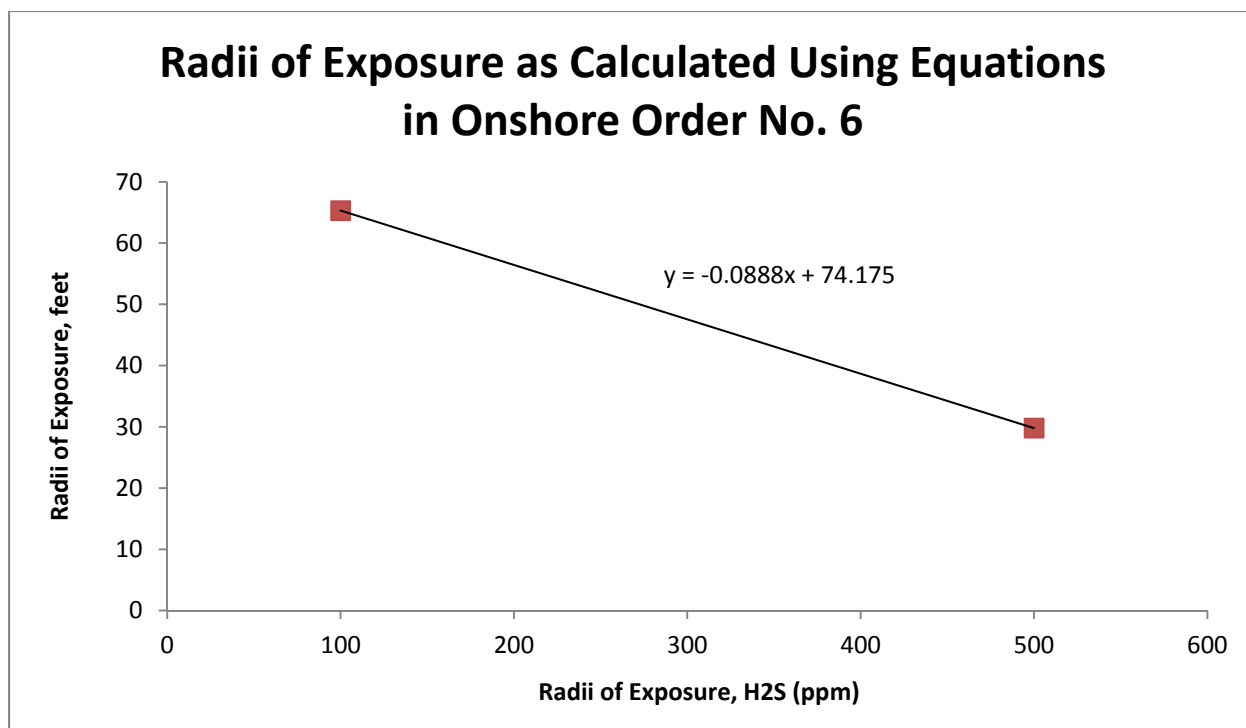


Figure 4-1. Radii of Exposure using Onshore Order No. 6 Equations

5.0 SITE DESCRIPTION, EVACUATION ROUTES, AND ROAD BLOCK INFORMATION

The well site is located in rural Cheyenne County, Colorado, approximately 2.5 miles south/southeast of Kit Carson. The surface footprint area of the well pad is approximately 2.6 acres.

The Heart 22-15-48 #1H well pad is located in an area with little local topographic relief. The topography slopes gently from northwest to northeast. There are no other structures in close proximity to the site. The prevailing winds in the area are generally out of the south (see Appendix B). The average annual precipitation in the area is approximately 14.52 inches per year.

Immediate evacuation routes from each site will depend on specific conditions at the time of release, including wind speed, wind direction, and nature of release. In general, the best evacuation route will be the most direct route cross wind and then upwind of the release. Heading for higher ground will also offer the best chance of safety in low or no wind conditions due to the vapor density of H_2S causing it to be a 'sinker' in air.

The evacuation route for the Heart 22-15-48 #1H location will be primarily dictated by wind direction as there is very little local topographic relief. Therefore the access road to the north of the site will be the preferred safe briefing area in typical conditions.

Given the nature of the release threat, the site is located in a rural area, and pedestrian and local traffic is very limited, it is not anticipated that roadblocks would be necessary. Chama personnel onsite would be responsible for limiting access to the site to only authorized emergency responders.

6.0 SAFETY EQUIPMENT LIST

1. During normal operations (no H₂S present), the Chama representative will be responsible for the following:
 - a. Ensure that all well site safety equipment is in place and operational.
 - b. Ensure that all well site personnel are familiar with the location, safety layout, and operation of all safety equipment.
 - c. Assist in performing H₂S drills for location personnel.
2. The H₂S detection equipment will be calibrated as recommended by the manufacture. Calibration records will be maintained on location.
3. The H₂S equipment shall be stored, inspected, and maintained according to manufacturer's recommendations.
4. At least one (1) windsock will be installed at the well site to ensure that wind direction can be readily determined by everyone on location.
5. All respiratory protective equipment will be NIOSH approved positive pressure type and maintained according to manufacturer's guidelines. All breathing air used for this equipment will be Compressed Gas Association (CGA) type Grade D breathing air.
6. There will be sufficient numbers of supplied air breathing equipment on location to ensure that all personnel on location have one (1) piece of equipment available to them.

Table 6-1. On-Site Equipment List

Amount	Description
Two (2)	Scott AV2000 facemask
Two (2)	Scott Ska-Pak supplied air respirators - 5 minute cylinder time
One (1)	BW Gas Alert Extreme Gas Detectors with carrying case
One (1)	25 person first aid kit
Five (5)	H ₂ S indicator tubes (100-2000 ppm)
Five (5)	H ₂ S indicator tubes (0.1-2%)
One (1)	Hand pump kit specific to brand of H ₂ S indicator tubes
One (1)	Wind socks
One (1)	Safe Briefing Area (SBA) signs
Two (2)	30 pound ABC fire extinguishers

7.0 TRAINING AND DRILLS

All personnel who come onto the well site location must be properly trained in hydrogen sulfide safety. The personnel shall carry documentation with them indicating that the training has occurred within the previous 12 months.

Training topics shall include at a minimum:

- Hazards and characteristics of hydrogen sulfide and sulfur dioxide atmospheres and symptoms of exposure to these gases.
- Sources of hydrogen sulfide and sulfur dioxide.
- Wind direction consciousness and escape routes.
- Proper use, care and limitations of respiratory protective equipment with hands on practice.
- Use of both fixed and portable toxic gas detection equipment.
- Recognition of and proper response to warning signals from gas detection equipment.
- Work practices to reduce opportunities for toxic gas exposure as well as confined space procedures.
- First aid for toxic gas exposure and resuscitation equipment.
- Emergency evacuation procedures and locations of safety equipment.
- Fire extinguisher instruction.
- A review of the contingency plan for the well site.

H₂S drills will be conducted at least weekly to ensure that all well site personnel are competent in emergency donning procedures. All training, drills, results, and personnel involved will be documented and maintained onsite and at the Chama Corporate office.

Safe briefing areas should be located using prevailing wind data for the area and should be outside the calculated 10 ppm radius of exposure (see Table 4-1).

8.0 CHARACTERISTICS OF HYDROGEN SULFIDE AND SULFUR DIOXIDE

Gas produced during drilling operations could be a mixture of carbon dioxide, hydrogen sulfide, and methane.

8.1 PROPERTIES OF HYDROGEN SULFIDE

Hydrogen sulfide is a colorless, transparent, and flammable gas. It is heavier than air and may accumulate in low places. Although the slightest presence of H₂S in the air is normally detectable by its characteristic “rotten egg” odor, it is dangerous to rely on the odor as a means of detecting excessive concentrations because the sense of smell is rapidly lost, allowing lethal concentrations to be accumulated without warning (OSHA, 2005). The following table indicates the properties of hydrogen sulfide.

Table 8-1. Properties of Hydrogen Sulfide

Chemical Formula	H ₂ S
CAS Number	7783-06-4
Specific Gravity (air = 1.00)	1.18 at 59 F (15 C) and 1 atm
Color	None
Odor	Compared to rotten eggs
Odor Threshold	0.13 ppm with olfactory fatigue common
Solubility	Soluble in water and oil
Vapor Pressure	19.6 atmospheres at 25 C
Flammable Limits	4.3% to 46% by volume in air
Ignition Temperature	500 F (260 C) (burns with a pale flame)
Molecular Weight	34.08 g/mol
Boiling Point	-77F (-60.5 C)
Freezing Point	-122 F (-85.5 C)

Hydrogen sulfide affects the central nervous system and oxygen utilization in the body. Inhalation is the primary exposure pathway. The following table lists physical effects at various concentrations.

Table 8-2. Physical Effects from Exposure to Hydrogen Sulfide

Concentration	Physical Effect
10 ppm	Beginning eye irritation
50 – 100 ppm	Slight conjunctivitis and respiratory tract irritation after 1 hour exposure.
100 ppm	Coughing, eye irritation, loss of sense of smell after 2-15 minutes. Altered respiration, pain in the eyes, and drowsiness after 15-30 minutes, followed by throat irritation after 1 hour. Several hours' exposure results in gradual increase in severity of these symptoms and death may occur within the next 48 hours.
200 – 300 ppm	Marked conjunctivitis and respiratory tract irritation after 1 hour of exposure.
500 – 700 ppm	Loss of consciousness and possibility of death in 30 minutes to 1 hour.
700 – 1000 ppm	Rapid unconsciousness, cessation of respiration, and death.
1000 – 2000 ppm	Unconsciousness at once, with early cessation of respiration and death in a few minutes. Death may occur even if individual is removed to fresh air at once.

This information excerpted from the American National Standards Institute standard: Z37.2-1972 Acceptable Concentrations of Hydrogen Sulfide.

Table 8-3. Hydrogen Sulfide Occupational Exposure Limits

Exposure Limit	Value
ACGIH TLV STEL	15 ppm, 15 minutes
ACGIH TLV TWA	10 ppm, 8 hours
NIOSH REL Ceiling	10 ppm, 10 minutes
OSHA PEL Ceiling	50 ppm, 10 minute maximum
IDLH	100 ppm

ACGIH = American Conference of Governmental Industrial Hygienists

9.0 CONTINGENCY PLAN UPDATES

When a new or different operating condition becomes in effect or new information substantially affects the implementation of a response plan, the operator should modify this contingency plan to address such a change.

10.0 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

The work performed was based on project information provided by Client. If Client does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations. Failure to do so will vitiate Kleinfelder's recommendations.

Appendix A
Contact Information

INTERNAL NOTIFICATION LIST

NAME	ROLE	RESPONSIBILITIES	PHONE NUMBERS
Bob Schilling	Field Drilling Superintendent	Incident Response Coordinator	Office – (303) 542-1853 Cell – (720) 626-9567
Roy Merrill	Drilling Engineer/Field Manager	Incident Response Coordinator	Office – (303) 542-1853 Cell – (719) 429-2225
William Heard	Drilling Engineer	Incident Response Coordinator	Office – (432) 688-7448 Cell – (432) 230-8923
Davie Minyard	Operations Manager	Incident Response Coordinator	Office – (405) 843-5566 Cell – (405) 650-1207

EMERGENCY RESPONSE CONTRACTORS

Western Clean Up Corporation · 20804 East Hwy 34 · Fort Morgan, CO · 80701 · (970) 867-9507 · (888) 867-9507
Dirk A. Schwartz, 11598 Nucla St., Commerce City, CO, 80022 303-227-0718
Hart Crowser, Inc., 274 Union Blvd., Ste. 200, Lakewood, CO, 80228, 303-986-6950

FEDERAL, STATE AND LOCAL AGENCY CALL LIST

FEDERAL AGENCIES

If appropriate, always call the NRC first. The NRC will contact the Coast Guard and other appropriate federal agencies.

National Response Center (NRC): 1-800-424-8802 (24 Hour)

EPA Region VIII: 1-800-227-8914 (24 Hour)

NOTE: It is only necessary to contact the EPA if you cannot contact the NRC

STATE OF COLORADO

Colorado Oil And Gas Conservation Commission (303) 894-2100

In case of chemical release and for assistance with emergency coordination contact the Local Emergency Planning Committee (LEPC):

Cheyenne County Emergency Preparedness (719) 346-8538

Cheyenne County Sheriff (719) 767-5633

Colorado Office of Emergency Services (720) 852-6600

In the event of a health emergency:

Colorado Dept. of Public Health and Environment (303) 692-2000

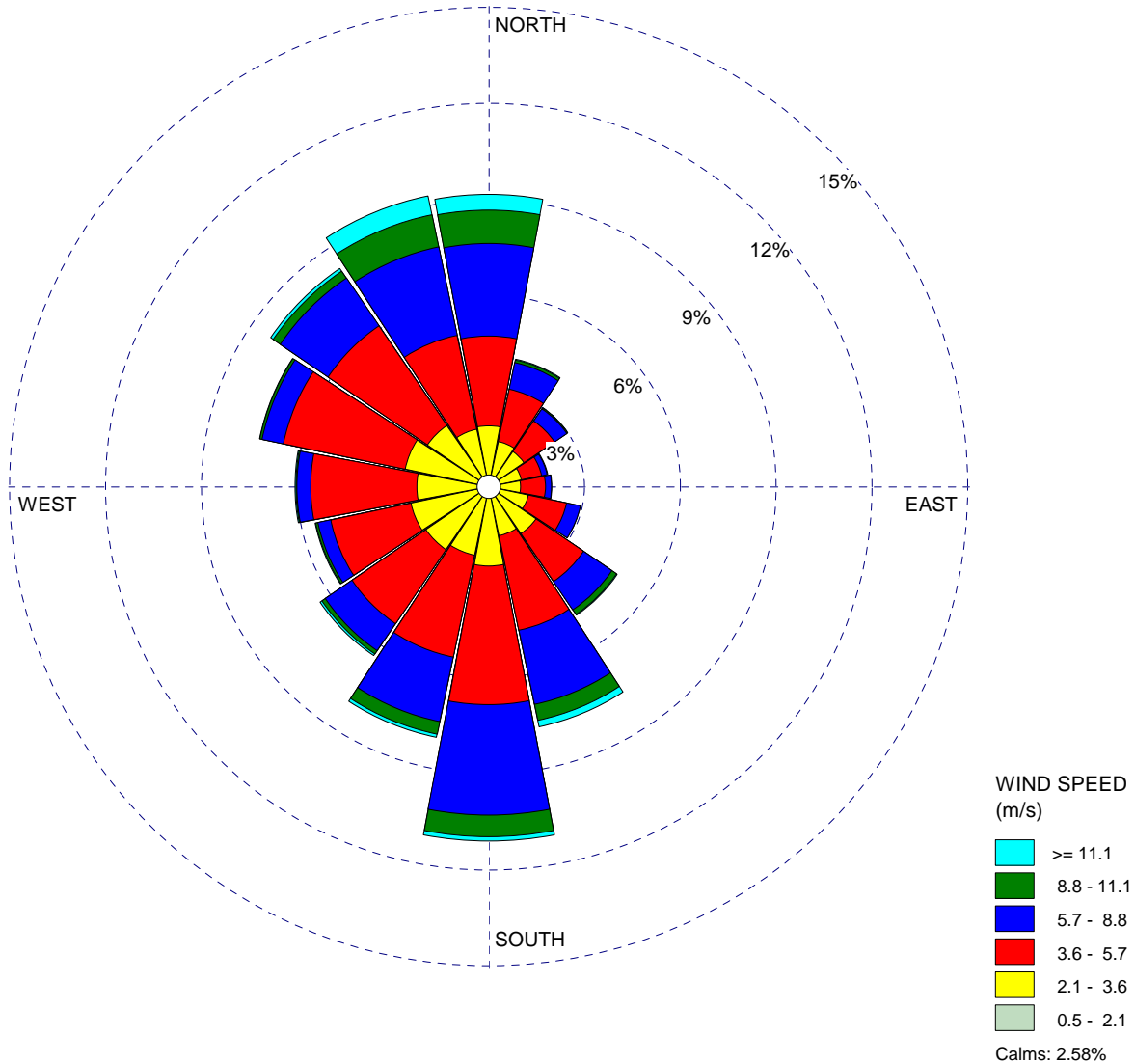
Appendix B

Wind Rose

WIND ROSE PLOT:

Limon, Colorado Wind Rose (1991-1992)

DISPLAY:

**Wind Speed
Direction (blowing from)**

COMMENTS:

DATA PERIOD:

**Start Date: 1/1/1991 - 00:00
End Date: 12/31/1992 - 23:00**

COMPANY NAME:

Kleinfelder

MODELER:

Dustin Collins

CALM WINDS:

2.58%

TOTAL COUNT:

17544 hrs.

AVG. WIND SPEED:

4.58 m/s

DATE:

11/28/2012

PROJECT NO.: