



## **H2S CONTINGENCY PLAN**

**CB-4**

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## **I. INTRODUCTION**

H<sub>2</sub>S is a toxic, poisonous gas that could cause death or injury. The objective of this contingency plan is to provide an organized plan of action for alerting and protecting the public from H<sub>2</sub>S exposure in the event a potentially hazardous volume is accidentally released to the atmosphere. This plan should be activated immediately if any such release occurs. The Drilling Supervisor is responsible for initiating and carrying out the plan.

## **II. TRAINING PROGRAM**

All personnel associated with the drilling operations will receive training to insure efficient and correct action in various potential situations. This training will be in the general areas of: (1) personnel safety, (2) rig operations, and (3) well control procedures.

**A. Personnel Safety Training** – All personnel shall have received H<sub>2</sub>S training in the following areas:

1. Hazards and characteristics of H<sub>2</sub>S.
2. Effect on metal components of the system.
3. Safety precautions.
4. Operation of safety equipment and life support systems.
5. Corrective action and shutdown procedures.

**B. Rig Operations** – All rig personnel shall have received training in the following areas:

1. Well control procedures.
2. Layout and operations of the well control equipment.

**NOTE:** Proficiency will be developed through BOP drills which will be documented by the Drilling Superintendent.

**C. Service Company Personnel** – All service personnel shall have been trained by their employers in the hazards and characteristics of H<sub>2</sub>S and the operation of safety equipment and life support systems.

**D. Visitors** – All first time visitors to the location will be required to attend a safety orientation. The Drilling Superintendent shall be responsible for this orientation and he shall see that every visitor is logged in correctly.

**E. Public** – The public within the area of exposure shall be given an advance briefing by Kinder Morgan personnel or representative. This briefing must include the following elements:

1. Hazards and characteristics of hydrogen sulfide. It is an extremely dangerous gas. It is normally detectable by its “rotten egg” odor, but odor is not a reliable means of detection because the sense of smell may be dulled or lost due to intake of the gas. It is colorless, transparent, and flammable. It is heavier than air and may accumulate in low places.
2. The necessity of an emergency action plan. Due to the danger of persons exposed to hydrogen sulfide and the need for expeditious action should an emergency occur, this action plan will be put into effect if a leak occurs.
3. The location of hydrogen sulfide within the area of exposure at the drilling location.

4. The manner in which the public will be notified of an emergency is by telephone or in person.
5. Steps to be taken in case of an emergency:
  - a. Abandon danger area.
  - b. Notify necessary agencies and request assistance for controlling traffic and evacuating people.

### **III. SITE IDENTIFICATION**

Operator Name: Kinder Morgan  
Well Name: Cow Canyon B4 (CB-4)  
Lat / Long: 37.56141 N / 108.92479 W  
Legal Location: 949' FSL & 906' FEL S10, T38N, R19W NMPM  
API Number: TBD

### **IV. KEY PERSONNEL RESPONSIBILITIES**

It is the responsibility of all personnel on the location to familiarize themselves with the procedures outlined in this contingency plan.

#### **A. All Personnel**

1. Are responsible for their assigned safety equipment.
2. Are responsible for familiarizing themselves with the location of all safety equipment.
3. Are responsible for reporting any indications of H2S to those in the area and to a supervisor.

#### **B. Drilling Supervisor**

1. Is responsible for thoroughly understanding and seeing that all aspects of this contingency plan are enforced.
2. Is responsible for implementing all phases of this contingency plan.
3. Is responsible for keeping a minimum of personnel on the location during expected hazardous operations.
4. Is responsible for coordinating all well site operations and communications in the event that an emergency condition develops.
5. Is responsible for ensuring that all visitors receive an H2S Safety Orientation. A visitor's log will be maintained as well as a list of all personnel on the location after drilling has progressed to the suspected H2S formation.

### **V. RESCUE AND MANAGEMENT PERSONNEL**

See Appendix A for the Emergency Contact List

## **VI. WELL SITE**

### **A. Rig Layout and Equipment**

There will be at least two pre-determined safe areas on location in the event of an emergency. These locations should be located 180 degrees to one another, and in the direction of the prevailing winds. See Appendix B.

### **B. Access, Egress and Roads**

See Appendix B and C

### **C. PPE for Essential Personnel**

The location and type of all air masks will remain the same for all drilling locations. Self-contained breathing apparatus for use by rig personnel will be kept in the following location(s):

Type: 1-30 Min. Rescue Unit	Location: Drilling Supervisor's Trailer
Type: 1-30 Min. Rescue Unit	Location: Tools Pusher's Trailer
Type: 2-30 Min. Rescue Units	Location: Briefing Area #1
Type: 2-30 Min. Rescue Units	Location: Briefing Area #2
Type: 5-5 Min. Escape Units	Location: Rig Floor

If a cascade system is utilized, indicate the locations(s):

Type:	Location:
Type:	Location:

Testing and calibration records are maintained on location.

### **D. H2S Detection and Monitoring Equipment**

See Appendix D. The rig's H2S monitor contains three (3) heads. One located at the bell nipple, one located at the shale shaker, and one on the rig floor. Personal H2S monitors are worn by all personnel on location. Indicate here any other additional H2S detector locations for this well:

Type:	Location:
Type:	Location:

Testing and calibration records are maintained on location.

### **E. Visual Warning Systems**

The location of windsocks or streamer will remain the same for all drilling locations. The wind direction indicators for this well will be located at:

Type: Windsock	Location: Briefing Area #1
Type: Windsock	Location: Briefing Area #2
Type: Windsock	Location: Pits
Type: Windsock	Location: Rig Floor

The location of any other safety equipment used, such as flare guns or bug blowers will be located at:

Type: Hand Held Detector & Tubes

Location: Rig Floor

Type:

Location:

Warning Signs:

1. Smoking will not be allowed on location except where indicated with a "SMOKING PERMITTED" designation.
2. "POISON GAS" signs will be located at the entrance to location.

**NOTE:** All warning signs should be black and yellow in color and of readable size at a reasonable distance.

## **F. Operating Conditions**

Operating conditions are defined in three categories. A description of each of these conditions and the required action to take are given below.

### **CONDITION I - Normal Operating Conditions, Potential Danger, Operations Under Control**

Characterized by: Normal drilling operations and test operations in zones which contain or may contain H<sub>2</sub>S.

Warning Flag: Green

Alarm: None

Probable Occurrence: No detectable gas present at surface.

- General Action:
1. Know location of safety equipment.
  2. Check safety equipment for proper function. Keep it available.
  3. Be alert for a condition change.
  4. Follow instructions of the supervisor.

### **CONDITION II - Potential to Moderate Danger to Life**

Characterized by: H<sub>2</sub>S gas present. Concentration less than 10 PPM.

Warning Flag: Yellow

Alarm: Flashing light at 10 PPM H<sub>2</sub>S.  
Intermittent blasts on horn at 10 PPM H<sub>2</sub>S.

- Probable Occurrence:
1. As drill gas.
  2. As trip gas when circulating bottoms up.
  3. When a core barrel is pulled.
  4. When a well kick is circulated out.
  5. Surface pressure, well flow or lost returns.
  6. Equipment failure during testing operations.

- General Action:
1. Follow instructions of supervisor.
  2. Put on breathing equipment if directed, or conditions warrant it.
  3. Stay in "SAFE BRIEFING AREA" if instructed and not working to correct the problem.

4. The Drilling Supervisor will initiate action to reduce the H<sub>2</sub>S concentration to zero.

**CONDITION III – Moderate to Extreme Danger to Life**

Characterized by: H<sub>2</sub>S present in concentrations at or above 10 PPM. Critical well operations or well control problems. In the extreme, loss of well control.

Warning Flag: Red

Alarm: Flashing light and continuous blast on horn at 10 PPM H<sub>2</sub>S.

Probable Occurrence: 1. As drill gas.

2. As trip gas when circulating bottoms up.

3. When a core barrel is pulled.

4. When a well kick is circulated out.

5. Surface pressure, well flow or lost returns.

6. Equipment failure during testing operations.

General Action: 1. Put on breathing equipment. Move to “SAFE BRIEFING AREA” and remain there if not working to correct the problem.

2. Follow instructions of Drilling Supervisor or other supervisor.

3. The Drilling Supervisor will initiate emergency action as provided in the contingency plan and as appropriate to the actual conditions. If testing operations are in progress, the well will be shut in.

4. The Drilling Supervisor will conduct any necessary operations with an absolute minimum of personnel. All persons in the immediate area will wear a breathing apparatus. All other personnel will restrict their movements to those directed by the Drilling Supervisor.

5. If gas containing H<sub>2</sub>S is ignited, the burning H<sub>2</sub>S will be converted to sulfur dioxide (SO<sub>2</sub>), which is poisonous.

**VIII. METALLURGY**

When operating in a zone with H<sub>2</sub>S present, certain equipment will be used that is constructed of materials with metallurgical properties that resist or prevent sulfide stress cracking and other failure modes. The following will be in effect:

- A. An effective means will be used for monitoring and controlling corrosion caused by acid gases (H<sub>2</sub>S and CO<sub>2</sub>) in both downhole and surface portions of a production system.
- B. Metals used for sensing lines and safety control devices which are necessarily exposed to H<sub>2</sub>S bearing fluids must be constructed of H<sub>2</sub>S corrosion resistant materials or coated so as to resist H<sub>2</sub>S corrosion.
- C. H<sub>2</sub>S resistant materials will be used for all elastomer seals.

Additionally because CO<sub>2</sub> is produced from the reservoir, all materials exposed to the production stream are CO<sub>2</sub> compliant.

## **VIII. WELL CONTROL**

### **A. Equipment**

See Appendix E

### **B. Testing and Inspection**

Routine blowout preventer assembly pressure and operating tests shall be made:

1. following installation of assembly and prior to drilling out after each string of casing is set
2. at least monthly while drilling
3. prior to drilling into a known abnormally pressured section
4. following repairs or replacement that require disconnecting a pressure seal in the assembly
5. any other time deemed necessary by the Kinder Morgan Representative

Preventer operating tests will be performed on each round trip but not more than once per day.

## **IX. MUD PROGRAM**

Hole Size: 8-3/4"

Mud Type: Salt saturated brine

pH: 11+, as required to control H<sub>2</sub>S

Maximum salt concentration expected: 190,000 ppm

Problems: H<sub>2</sub>S, Paradox Salt Shale gas influx, hole cleaning

Displace the fresh water system with salt saturated brine 100' above the Desert Creek formation. Circulate through the closed loop system to maintain a clean fluid and to assist in breaking out any entrained gas.

Pre-treat mud for H<sub>2</sub>S prior to drilling the P4 Shale.

Follow the guidelines for drilling the Paradox Salt Shale, titled "Paradox Salt Drilling Procedure", which is located in Appendix A of the drilling prognosis. The recommendations have proven to be very successful in recent drilling programs.

## **X. PROCEDURES**

### **A. Operating**

The following operating procedures will be utilized for drilling in areas with H<sub>2</sub>S.

1. Any gas kick will be controlled by using approved well control techniques. Upon evidence that ambient H<sub>2</sub>S concentrations have reached 10 PPM, all non-essential personnel will be evacuated to pre-determined safe areas. Personnel remaining on the rig floor will continue to control the well until the situation indicates the area is safe to re-enter.
2. Special Operations



- a. Drill Stem Tests. All drill stem tests must be closed chamber and conducted during daylight hours.
- b. Coring. After a core has been cut, circulate bottoms up and monitor for H<sub>2</sub>S. If hole conditions (and/or detectors) indicate potentially hazardous conditions, put breathing equipment on 10 stands before core barrel reaches the surface. Breathing equipment will be worn by all personnel while core barrel is pulled, broken out and opened up, and until a safe atmosphere is indicated.

## B. Emergency

The procedures listed below apply to drilling and testing operations.

1. If at any time during Condition I, the Mud Logger, Mud Engineer, or any other person detects H<sub>2</sub>S, he will notify the Drilling Supervisor. All personnel should keep alert to the Drilling Supervisor's orders.

He will:

- a. Immediately begin to ascertain the cause or the source of the H<sub>2</sub>S and take steps to reduce the H<sub>2</sub>S concentration to zero. This should include having the mud engineer run a sulfide and Ph determination on the flowline mud if water-base mud is in use. If an oil-base mud is in use, the Mud Engineer should check the lime content of the mud.
  - b. Order non-essential personnel out of the potential danger area.
  - c. Order all personnel to check their safety equipment to see that it is working properly and in the proper location. Persons without breathing equipment will not be allowed to work in a hazard area.
  - d. Notify the Rig Supervisor of the condition and action taken.
  - e. Increase gas monitoring activities with portable H<sub>2</sub>S detectors and continue operations with caution.
  - c. Display the orange warning flag.
2. If the H<sub>2</sub>S concentration exceeds 10 PPM the following steps **will** be taken:
    - a. Put on breathing equipment.
    - b. Display red flag.
    - c. Driller – prepare to shut the well in.
      - i. Ensure tool joint out of BOP's
      - ii. Close BOP's if necessary.
    - d. If testing operations are in progress, the well will be shut-in.
    - e. Help anyone who may be affected by gas.
    - f. Evacuate quickly to the "SAFE BRIEFING AREA" if instructed or conditions warrant.
  3. In the event a potentially hazardous volume of H<sub>2</sub>S is released into the atmosphere, the following steps must be taken to alert the public:

- a. Remove all rig personnel from the danger area and assemble at a pre-determined safe area, preferably upwind from the well site.
- b. Alert the drilling office, public safety personnel, regulatory agencies, and the general public of the existence and location of an H<sub>2</sub>S release. See attached emergency contact list.
- c. Assign personnel to block any public road (and access road to location) at the boundary of the area of exposure. Any unauthorized people within the area should be informed that an emergency exists and be ordered to leave immediately.
- d. Request assistance from public safety personnel to control traffic and/or evacuate people from the threatened area.

## H<sub>2</sub>S Contingency Plan Emergency Contact List

Well Name: Cow Canyon B-4 (CB-4)API #: TBD

Date of Completion: \_\_\_\_\_ Date of Release: \_\_\_\_\_

NAME	ADDRESS	PHONE	# RESIDENT	Relocated Yes/No	Comments
Public Safety		C:			
		O: 911			
Montezuma County Sheriff		C:			
		O: 970-565-8452			
Montezuma County Planner		C:			
		O: 970-565-2801			
Steve Lebowski - COGCC Field Ops		C: 970-946-5073			
		O: 970-259-0945			
Dave Andrews - COGCC Engineer		C: 970-456-5262			
		O: 970-625-2497			
EPA National Response Center		C:			
		O: 800-424-8802			
Poison Control Center		C:			
		O: 800-222-1222			
Rod Brashear - BLM Engineer (Monument)		C: 970-799-1244			
		O: 970-385-1347			
Ryan Joyner - BLM Nat Resource Specialist		C: 970-799-6619			
		O: 970-385-1242			
Todd Gentles - KM Drilling Manager		C: 713-249-2805			
		O: 713-369-8487			

Notes: \_\_\_\_\_

Submit Completed Form to KM Drilling Engineer, Drilling Superintendent and Regulatory Manager

## H<sub>2</sub>S Contingency Plan Emergency Contact List

Well Name: Cow Canyon B-4 (CB-4)

API #: TBD

Date of Completion: \_\_\_\_\_

Date of Release: \_\_\_\_\_

NAME	ADDRESS	PHONE	# RESIDENT	Relocated Yes/No	Comments
Barry Swift - KM Engineering Manager		C: 432-638-6209			
		O: 970-882-5545			
Chris Lopez - KM Project Manager		C: 505-699-9832			
		O: 970-882-5537			
Valerie Cawthorn - KM Drilling Engineer		C: 281-798-8769			
		O: 713-369-8509			
		C:			
		O:			
		C:			
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Notes: \_\_\_\_\_

Submit Completed Form to KM Drilling Engineer, Drilling Superintendant and Regulatory Manager

## H<sub>2</sub>S Contingency Plan Emergency Contact List

Well Name: Cow Canyon B-4 (CB-4)

API #: TBD

Date of Completion: \_\_\_\_\_

Date of Release: \_\_\_\_\_

NAME	ADDRESS	PHONE	# RESIDENT	Relocated Yes/No	Comments
Barry Swift - KM Engineering Manager		C: 432-638-6209			
		O: 970-882-5545			
Chris Lopez - KM Project Manager		C: 505-699-9832			
		O: 970-882-5537			
Valerie Cawthorn - KM Drilling Engineer		C: 281-798-8769			
		O: 713-369-8509			
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Notes: \_\_\_\_\_

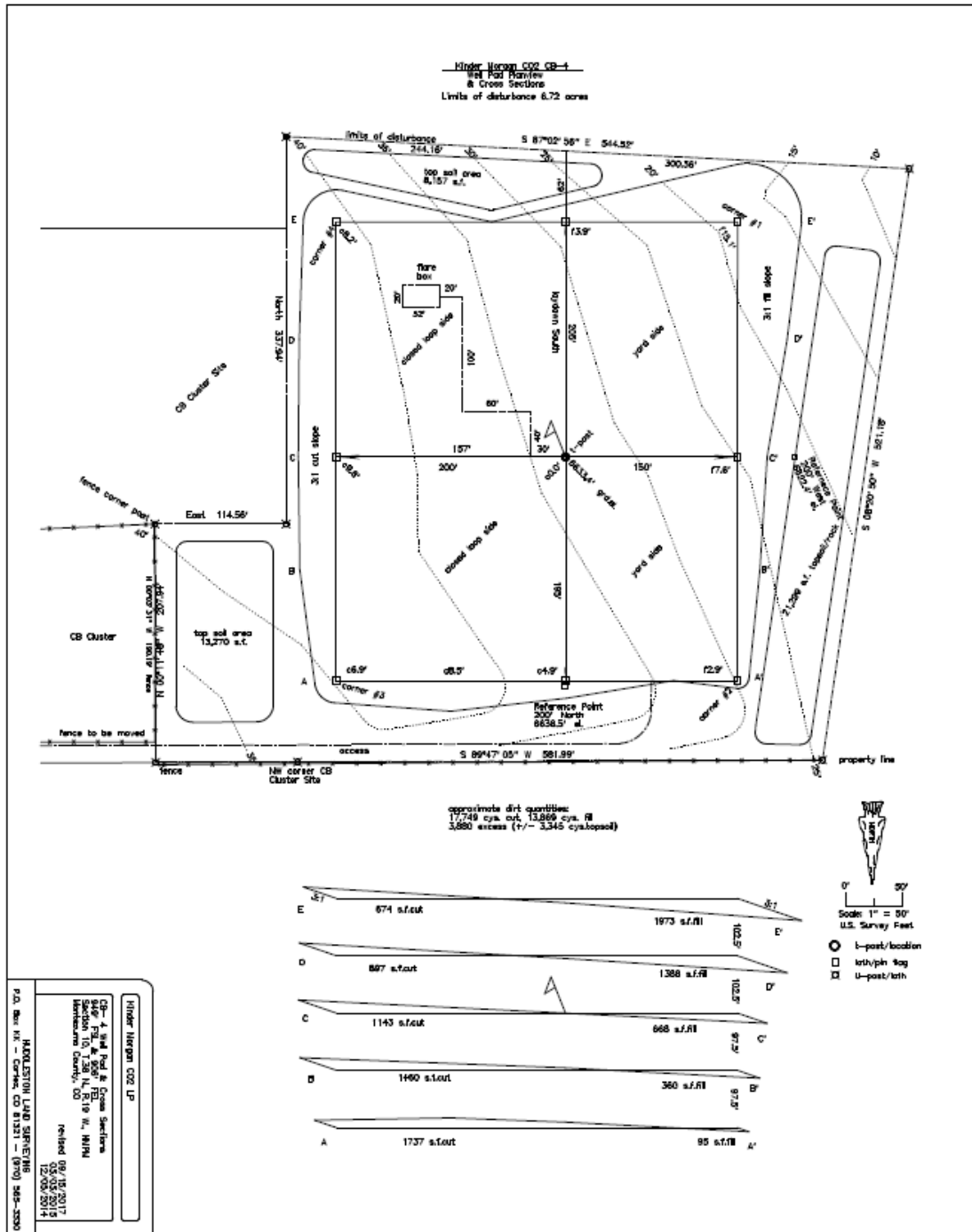
Submit Completed Form to KM Drilling Engineer, Drilling Superintendant and Regulatory Manager

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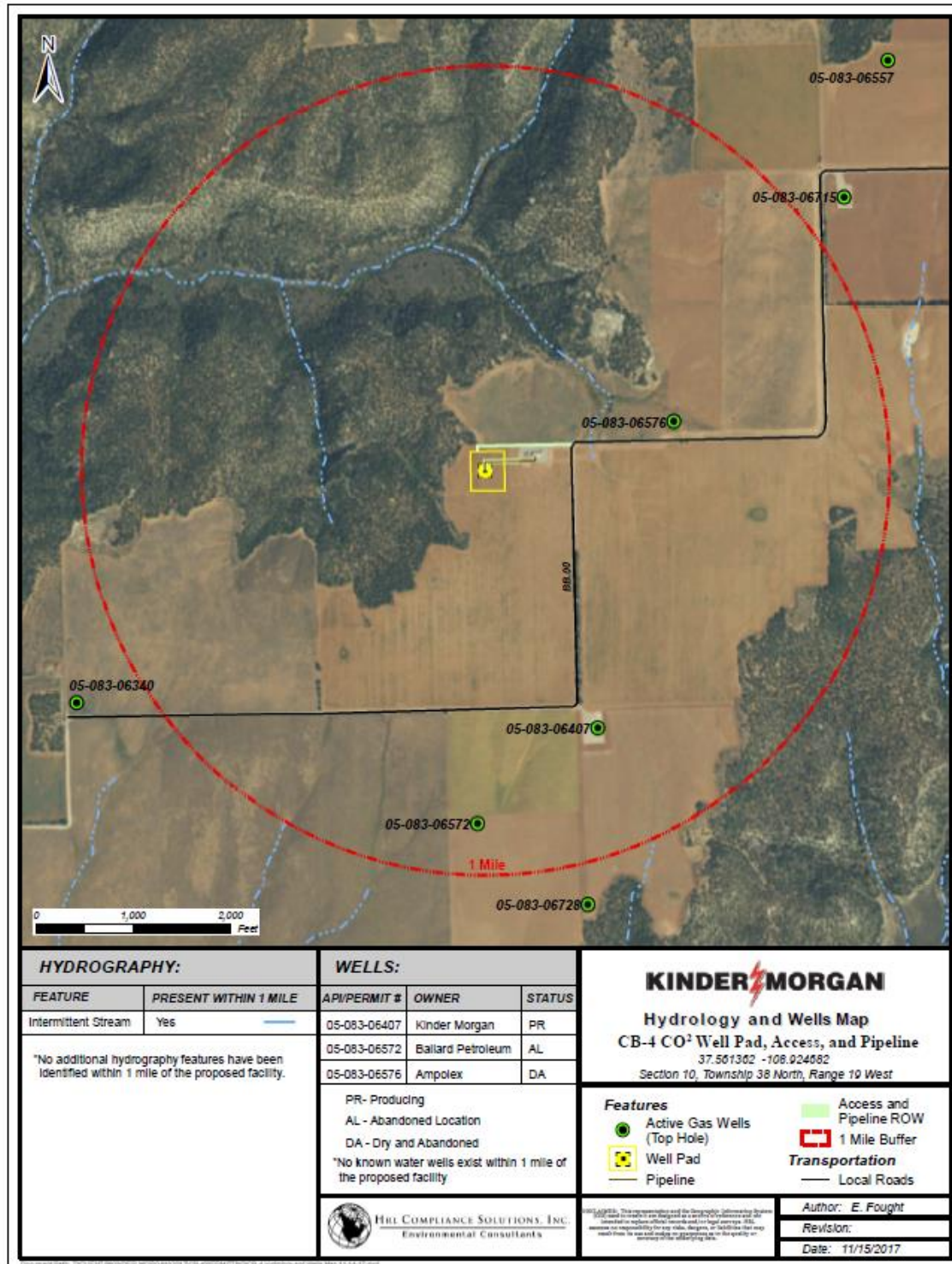
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## Appendix C: Access, Egress and Roads

Well Pad Map



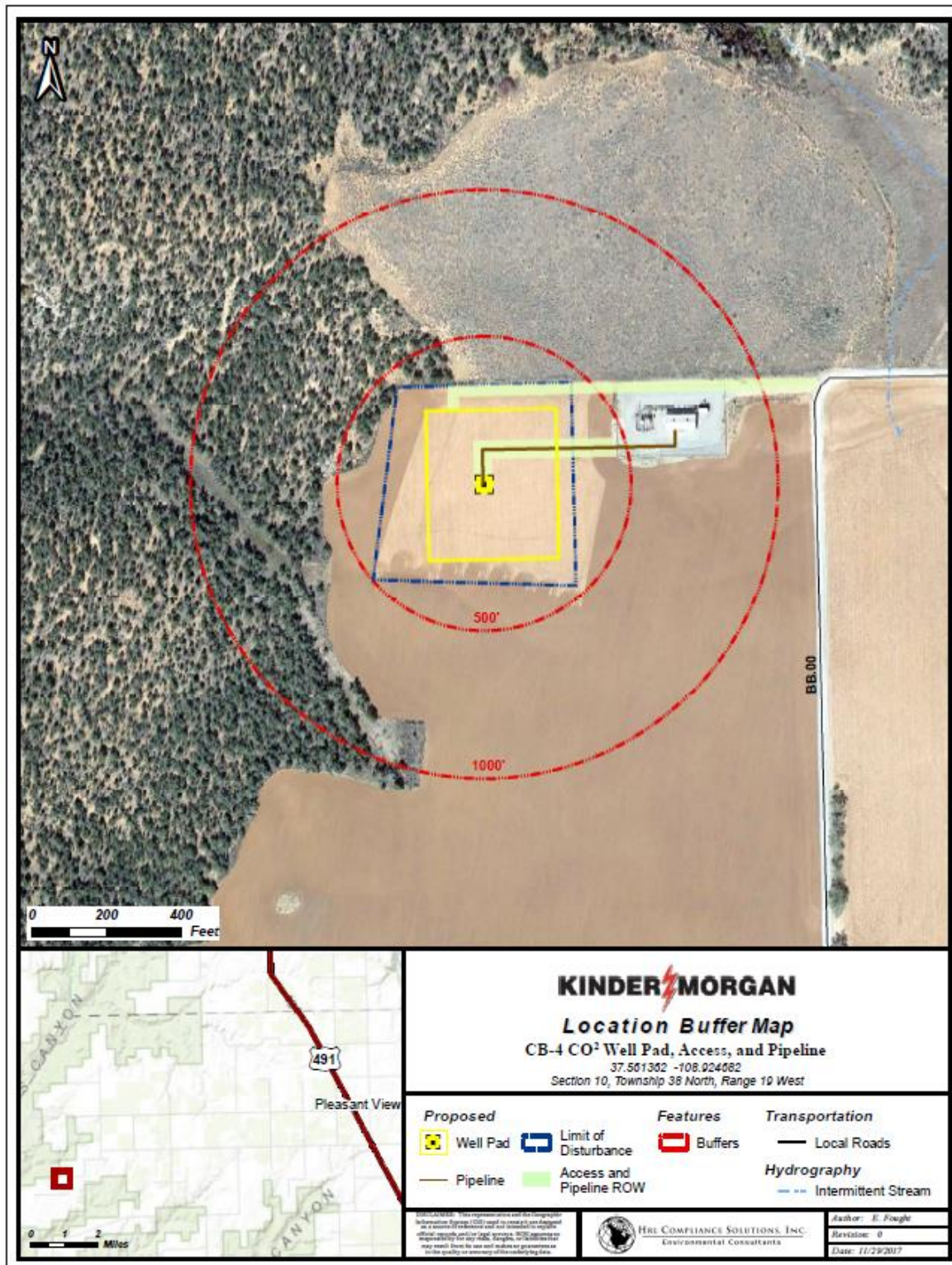
# Topographic Map





## Appendix D: Radius of Exposure

### Location Map



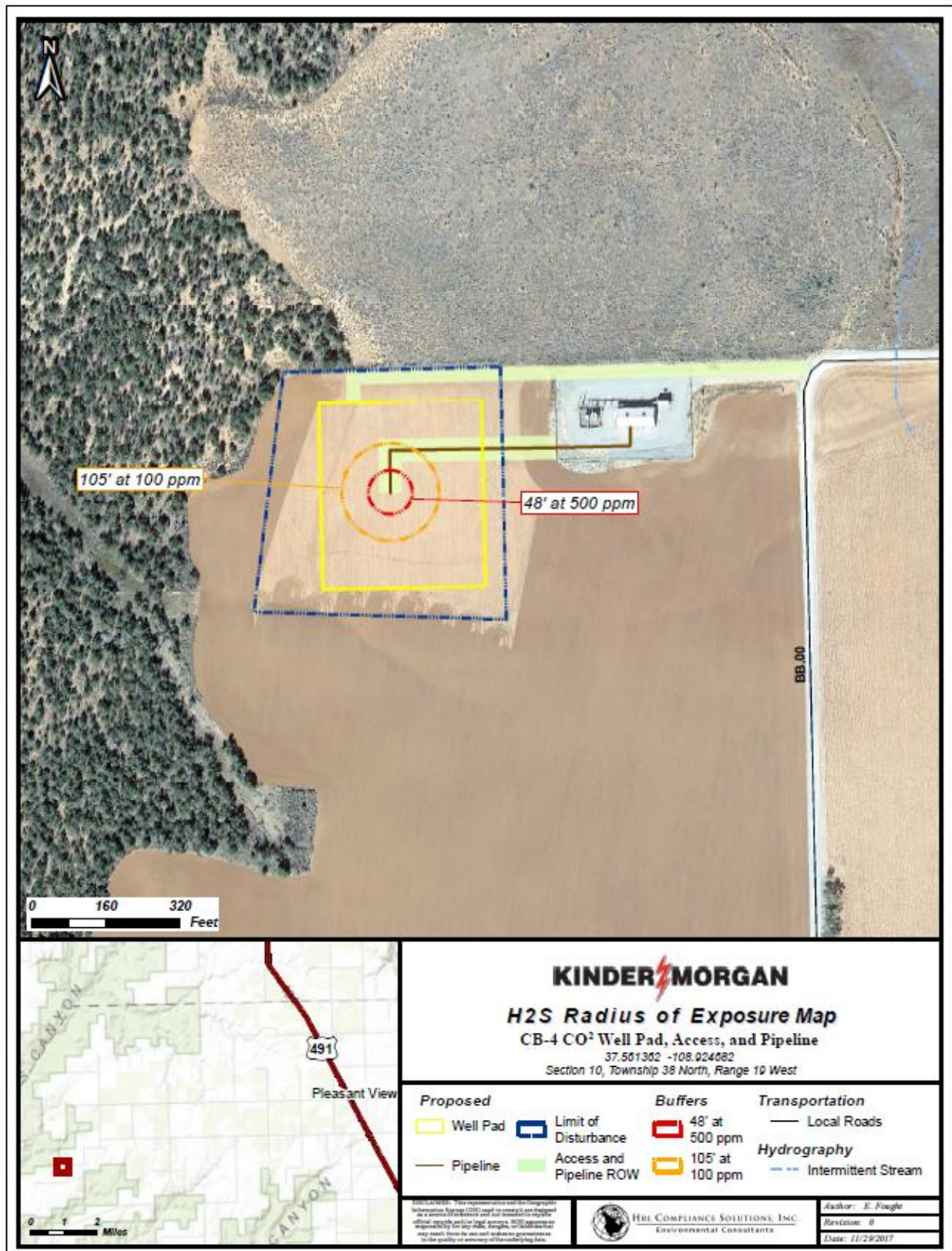
# Pasquill-Gifford Model

CB-4

CB-4						
Scenario:	9/7/2017					
flow rate, Q, cubic feet/day:		1,066,000				
H2S, mole %:		0.10%				
feet to 100 ppm radius of exposure:		105				
feet to 500 ppm radius of exposure:		48				
100 ppm radius of exposure = $[1.589(\text{mole fraction H}_2\text{S})(Q)]$ to the power of 0.6258, where Q is ft <sup>3</sup> /day						
500 ppm radius of exposure = $[0.4546(\text{mole fraction H}_2\text{S})(Q)]$ to the power of 0.6258, where Q is ft <sup>3</sup> /day						

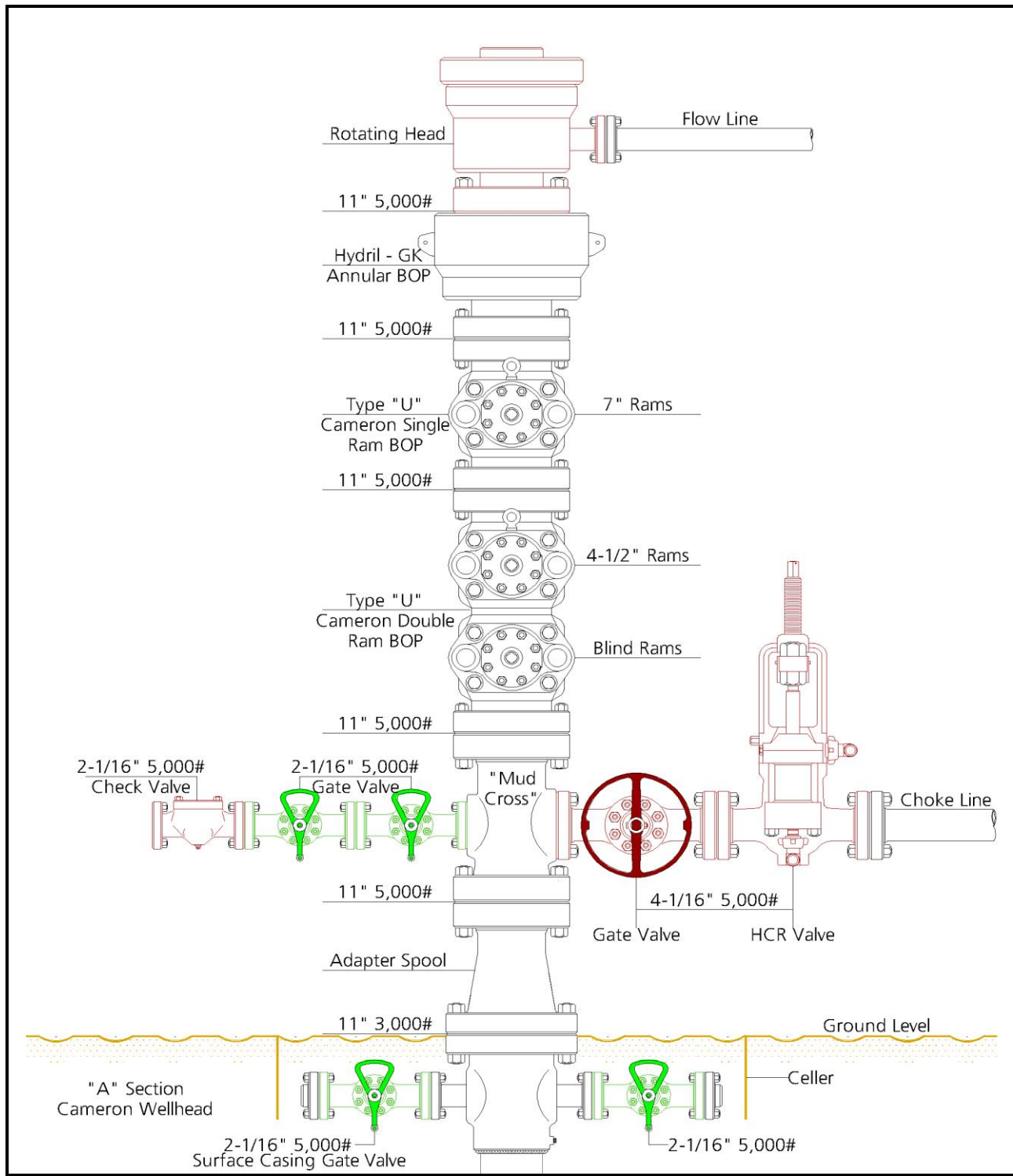


# Radius of Exposure Map



## Appendix E: Well Control Equipment

### Blowout Preventer



Choke Manifold

