







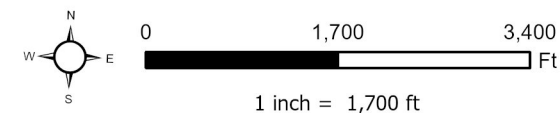


Geologic Hazard Map
Cascade Creek 697-15-08 Pad
Laramie Energy
SENE, Section 15, T6S R97W, 6th P.M.
Garfield County, Colorado

LEGEND

-  Existing Road
-  Proposed Road
-  Intermittent Stream
-  Perennial Stream
-  1 Mile Buffer from Edge of Proposed Working Pad Surface
-  Proposed Working Pad Surface
-  Landslides (DHSEM Hazard Risk, 2015)
-  Avalanches (DHSEM Hazard Risk)



Notes:

- 1) Landslide Inventory and Avalanche Hazard was obtained from the Colorado Geological Survey.
- 2) Please see the attached Geologic Hazards Assessment Report for a detailed review of the geologic hazard for this Oil and Gas Location.



330 Grand Avenue, Unit C
Grand Junction, CO 81501
970-549-1015

Map By: NDB

Date: 9/27/2021



October 4, 2021

Colorado Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801
Denver, CO 80203

**RE: Geological Hazards Map and Geological Hazards Assessment Report
COGCC Rule 304.b.(7).I and Rule 304.c.(21)
Cascade Creek 0697-15-08 Well Site, Garfield County, Colorado**

Dear COGCC Representative,

Attached you will find a Geologic Hazards Assessment Report and Geological Hazards Map for the Cascade Creek (CC) 0697-15-08 Well Site location. Laramie Energy LLC (Laramie) retained Entrada Consulting Group, Inc. (Entrada) to assess geologic hazards within one mile of the Working Pad Surface (WPS) of the CC 0697-15-08 Well Site.

The CC 0697-15-08 Well Site Geologic Hazards Assessment Report addresses "Geologic Hazards" as outlined by COGCC's Rules and Regulations and Colorado Revised Statutes (C.R.S.) § 24-65.1-103(8):

"Geologic hazard" means a geologic phenomenon which is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property. The term includes but is not limited to:

- (a) Avalanches, landslides, rock falls, mudflows, and unstable or potentially unstable slopes;*
- (b) Seismic effects;*
- (c) Radioactivity; and*
- (d) Ground subsidence.*

The CC 0697-15-08 Well Site Geologic Hazards Map was prepared in accordance with COGCC Rule 304.b.(7).I.:

Geologic Hazard Map. A map identifying any Geologic Hazards within a 1 mile radius of the proposed Working Pad Surface. For any identified Geologic Hazard that extends beyond the 1 mile radius, a second map scaled to show the extent of that hazard in relation to the proposed Oil and Gas Location.

Based on the definition of the geologic hazards stated above, the Geologic Hazard Map, and the references below, no geologic hazards were identified within one mile of the WPS. Per COGCC Rule 304.c.(21), a Geologic Hazards Plan is not required.



I certify that I am a Professional Geologist, having met the educational requirements and professional work experience required by C.R.S. § 23-41-208(b). I have reviewed information pertaining to this Oil and Gas location and the surrounding area, and have identified no Geologic Hazards within a one mile radius.

Sincerely,

S. Reed Johnson
Senior Project Geologist
Entrada Consulting Group
Date: October 4, 2021
Wyoming Licensed Professional Geologist #4165

Geological Hazards Map and Assessment Report References:

Department of Homeland Security Hazard Risk Map Server (Landslide and Avalanche Data)
<https://gis.colorado.gov/public/rest/services/DHSEM/HazardRisk/MapServer>

Hail, W.J., Jr., 1992, U.S.G.S. Bulletin 1787-R, *Geology of the Central Roan Plateau Area, Northwestern, Colorado*, 26 p.,

Hail, W.J., O'Sullivan, R.B., Smith, M.C., 1989, U.S.G.S. Miscellaneous Investigations Series, Map 1-1797-C, *Geologic Map of The Roan Plateau Area, Northwestern Colorado*, 1 map sheet

Nelson-Moore, J.L., Bishop C.D., and Hornbaker, A.L., 2005, Colorado Geologic Survey, Bulletin 40, *Radioactive Mineral Occurrences of Colorado*, 1054 p.

White, J. L., and Greenman, C., 2008, *EG-14 Collapsible Soils in Colorado*, Colorado Geological Survey, Department of Natural Resources, 108p, 1 map sheet

Other References:

American Geosciences Institute/Colorado Division of Reclamation Mining and Safety. Interactive Map of Mines in Colorado.
<https://www.americangeosciences.org/critical-issues/maps/interactive-map-mines-colorado>



Colorado Department of Public Health and Environment – Radon

<https://cdphe.colorado.gov/understanding-radon>

Colorado Department of Homeland Security and Emergency Management

<https://dhsem.colorado.gov/>

Garfield County Natural Hazard Mitigation Plan

<https://www.garfield-county.com/emergency-management/natural-hazard-mitigation-plan/>

Oregon State University - Prism Climate Group

<https://prism.oregonstate.edu/>

USDA Natural Resources Conservation Service, Web Soil Survey

<https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>

USGS Earthquake Hazards Program

<https://earthquake.usgs.gov/>

C.R.S. § 23-41-208(b) Professional Geologist Qualifications:

S. Reed Johnson

Environmental Geologist | Petroleum Geologist
Entrada Consulting Group, 330 Grand Ave., Grand Junction, CO 81501
720-253-2940 | rjohnson@entradainc.com

Relevant Employment History:

Entrada Consulting Group, Denver, CO and Grand Junction, CO:
Senior Project Geologist.

July 2019 - Present

Vermilion Energy USA Inc., Denver, CO:
Senior Geologist.

February 2015 - October 2018

Resolute Energy, Denver, CO:
Geologist.

December 2013 - February 2015

Comet Ridge Resources LLC, Denver CO:
Geologist.

August 2011 - November 2013

Encana Oil and Gas Inc., Denver, CO:
Geologist.

January 2007 - August 2011

Cabot Oil and Gas Corporation, Denver, CO:
Geology Intern.

May 2006 - August 2006

Education:

West Virginia University, Morgantown, WV, Master of Science, Geology
Western Carolina University, Cullowhee, NC, Bachelor of Science, Geology

May 2007
December 2003

Geologic Hazards Assessment
Laramie Energy
Cascade Creek 0697-15-08 Well Site



Project Number 021-036

October 4, 2021

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1.0 INTRODUCTION

Laramie Energy LLC (Laramie) retained Entrada Consulting Group, Inc. (Entrada) to develop a Limited Desktop Geological Hazards Assessment for submittal to the Colorado Oil and Gas Conservation Commission(COGCC) for the proposed Cascade Creek 0697-15-08 Well Site (the Site). This report was developed using publicly available information and did not include sample collection, analyses, or site visits.

2.0 SITE OVERVIEW

The Site is located on the Roan Plateau which lies within the Piceance Creek Basin and the Colorado Plateau physiographic region. The topography of the area consists of rolling hills atop a plateau that is bounded by cliffs and cut by deeply incised, steep walled canyons. The Site is located on topographic high-ground 16 miles northwest of Parachute, Colorado at an approximate elevation of 8,502.8 feet above mean sea level. The Site is located in the SENE of section 15, range 97W, township 6S. Latitude and Longitude for the Site are 39.526319°, -108.198886° respectively.

The Site will be developed on undisturbed ground. The proposed area of disturbances is approximately 7.6 acres. After drilling and completions activities, interim reclamation will result in 5.8 acres being reclaimed. Post interim reclamation, the Site will be approximately 1.9 acres in size.

3.0 GEOLOGIC HAZARDS

A geologic hazard assessment was conducted within one-mile radius of the proposed site location. In accordance with COGCC Rule 304.b.(7).I., a **Geologic Hazard Map** was developed for the Form 2A Location Assessment. This Geologic Hazard Assessment Report addresses “Geologic Hazards” as outlined by COGCC’s Rules and Regulations and Colorado Revised Statutes § 24-65.1-103(8).

3.1 AVALANCHES

According to the Garfield County Multi-Jurisdictional Hazard Mitigation Plan most avalanches occur on slopes from 30 to 50 degrees. Localized slope angles do exceed 30 degrees. However, the Site is not within the higher precipitation and mountainous areas of Garfield County where avalanches tend to occur. Furthermore, the Site is located atop a ridge and thus the likelihood of an avalanche occurring within the perimeter of the Oil and Gas Location is low.

3.2 LANDSLIDES

The Site is not located in a known Landslide Hazard area. Landslide deposits have been mapped in nearby Garden Gulch, Cascade Canyon, Conn Creek Canyon, and other unnamed canyons in the area. Nearby landslide deposits are not located within a one-mile radius of the Site as indicated in the **Geologic Hazard Map**.

3.3 ROCKFALLS

The Site is not located in a known Rockfall Hazard area. The Site is located on a topographic high with no upslope rock outcrops.

3.4 MUDFLOWS OR DEBRIS FLOWS

The Site is not located in a known Mudflow or Debris Flow Hazard area. The Site is located on a topographic high within a greater plateau.

3.5 UNSTABLE OR POTENTIALLY UNSTABLE SLOPES

The Site will be constructed near the apex of a ridge where flanking slopes locally exceed 50%. However, the site will be graded to less than 20%. Bedrock typically exists 25-60 inches below ground surface in the soil profiles encountered at the Site according to the NRCS. Numerous oil and gas pads exist on similar ridges throughout the region. Unstable slopes are not a geological hazard at this Site.

3.6 SEISMIC EFFECTS

The Site is not located above any known mapped faults. The closest faults known to have shown surface deformation due to large earthquakes in the last 1.6 million years are the Redlands Fault complex near Grand Junction and the Grand Hogback Fault complex near Glenwood Springs.

The Colorado Geological Survey (USGS) Earthquake Hazards Program online records were researched for seismic activity dating back to 1867. Twenty-two earthquakes greater than magnitude 2.5 exist in the dataset for Garfield County. The largest earthquake in the dataset was from the Atomic Energy Commission Rulison Project nuclear detonation (magnitude 5.3) in 1969. The largest natural earthquake was a magnitude 4.3 that occurred due south of Glenwood Springs in 1971. Only one earthquake has occurred within a five-mile radius of the site. This was a magnitude 2.9 that occurred in 2015 and was located 3.02 miles southwest of the Site. Earthquakes do not present a significant hazard at this Site.

3.7 RADIOACTIVITY

Review of the Colorado Department of Public Health and Environment website for Radon information indicates that Garfield County has high radon potential. It is anticipated that based on the proposed project for the Site, that limited structures and buildings will be developed, and workers will predominantly be outside during the normal work shifts; therefore, radon is not expected to represent a significant geologic or worker exposure health hazard.

Naturally occurring radioactive minerals are common Garfield County. However, they are not anticipated in the geologic section exposed at this Site.

3.8 GROUND SUBSIDENCE

The Site is not located in an area that is known to have been impacted by mining operations, karst dissolution, groundwater related subsidence, or collapsible soils. Significant subsidence is not anticipated.

3.9 CORROSIVE SOILS

A soils report from the Natural Resource Conservation Service (NRCS) indicates that within the proposed Oil and Gas Location and part of the surrounding area is composed of Parachute-Irigul complex, Northwater-Adel complex, and Parachute-Irigul-Rhone association. The Parachute-Irigul complex and Northwater-Adel complex have low corrosiveness ratings for uncoated steel and concrete per the USDA Natural Resources Conservation Service. The Parachute-Irigul-Rhone association has a moderate corrosiveness rating for uncoated steel and a low corrosiveness rating for concrete. Corrosive soils do not present a significant geohazard at this Site.

4.0 CONCLUSIONS AND SUMMARY

Based on this Limited Desktop Geological Hazards Assessment of publicly available information, there are no known Geological Hazards within the Cascade Creek 0697-15-08 Well Site.

5.0 REFERENCES

Please see the cover letter for a reference list for the Geological Hazard Map and this report.

Sincerely,



S. Reed Johnson
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Email: rjohnson@entradainc.com