# ECMC Geologic Hazards Map and Geologic Hazards Plan Operator Guidance

## Form 2A

## Rule 304.b.(7).I. and 304.c.(21). - Geologic Hazard Map and Plan

# Document Control

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# Rule Citation

### 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 is scaled to show the extent of that hazard in relation to the proposed Oil and Gas Location.

### 304.c.(21). Geologic Hazard Plan

If the Operator identifies any Geologic Hazards pursuant to Rule 304.b.(7).I, the Operator will submit a Geologic Hazard plan describing proposed mitigation measures.

# Purpose of Geologic Hazard Map and Geologic Hazard Plan

The purpose of these rules is to protect public health, safety, welfare, the environment, and wildlife resources by identifying, avoiding, or mitigating geologic hazards associated with potential Oil and Gas Locations.

A Geologic Hazard Map must always be attached to a Form 2A pursuant to Rule 304.b.(7).I.

A Geologic Hazard Plan is only required when there are Geologic Hazards identified within 1 mile of the Oil and Gas Location during the preparation of the Geologic Hazards Map.

# Guidance/Requirements

## Identifying Geologic Hazards

- **Geologic Hazard** is defined in § 24-65.1-103(8), C.R.S. - (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.

- When assessing geologic hazards, rely on the statutory definition which states "the hazard must be so adverse as to constitute a significant hazard." The listed statutory hazards shown on the map should be significant to oil and gas development.

- At a minimum, the maps should address all potential Geologic Hazards within one mile (avalanches, floods, landslides, rockfall, mudflows and debris fans, unstable slopes, seismic effects and earthquakes, ground subsidence, expansive soil or bedrock, collapsible soils, corrosive soils, and radioactivity), that could reasonably affect development of the Oil and Gas Location.

## Set of Requirements for Map

1. At a minimum, the maps should address all potential Geologic Hazards within one mile (avalanches, floods, landslides, rockfall, mudflows and debris fans, unstable slopes, seismic effects and earthquakes, ground subsidence, expansive soil or bedrock, collapsible soils, corrosive soils, and radioactivity), that could reasonably affect development of the Oil and Gas Location. If potential

Geologic Hazards do not exist within one mile of the Location, the maps should state that No Geologic Hazards were identified.

2. The Geologic Hazard Maps prepared for submittal on a Form 2A will include a scale bar, a north arrow, a legend of all symbols to identify pertinent features and identified geologic hazards on the attachment, and a title block that identifies the Operator's name, Oil and Gas Location name, location identification (quarter/quarter, section, township, range, county), and any other relevant location information.

3. The map scales should be selected to optimize the amount of detail to clearly show the planned Oil and Gas Location and all surrounding features within one mile.

4. Review of other published geologic maps and reputable sources of geologic hazard data may be required to prepare the maps. Provide a list of the sources used to identify geologic hazards reviewed to prepare the Geologic Hazards maps.

5. If the geologic hazard is not seen as a critical concern to the area, such as collapsible soils in an area with little to no topography or a fault not within the mineral development area, a statement should be added to the map explaining why the geologic feature identified is not considered a hazard or concern to safety, health, and welfare to the area.

6. The Geologic Hazard Map should be stamped and certified by a qualified individual, such as a Professional Geologist.

## Set of Requirements for Plan

If potential Geologic Hazards are identified during review and preparation of the Geologic Hazard Maps (Rule 304.b.(7).I.), the Operator will need to submit a Geologic Hazard Plan (Rule 304.c.(21).) prepared by a Professional Geologist, as defined by Colorado Statute C.R.S. 23-41-208. In preparation of a Geologic Hazard Plan, a Professional Geologist will review published geologic maps and reports prepared by

the United States Geological Survey (USGS), Colorado Geological Survey (CGS), other relevant published geologic hazard data, or site-specific geologic maps prepared by a Professional Geologist employed by an Operator, or outside consulting firm or engineering firm. The Professional Geologist(s) will be identified by name in the plan.

1. The Professional Geologist will conduct a site visit of the proposed location to further assess potential Geologic Hazards at the location.

2. If no Geologic Hazards are identified, or the Professional Geologist determines that the geologic conditions identified do not pose a significant risk to development of the Oil and Gas Location, a statement should be made on the map indicating that the geologic hazards present at or near the proposed location pose little risk through minimization or mitigation measures, or are determined to be so minimal as to pose no concern; and therefore, a Geologic Hazard Plan is not necessary.

3. If the Oil and Gas Location lies within a mapped Geologic Hazard(s) area, or lies within one mile of potential Geologic Hazard(s), the Professional Geologist and Operator will consider the significance of the hazard to the Oil and Gas Development and discuss avoiding that location, or whether adequate minimization and mitigation measures can be implemented to address the hazard(s).

4. Oil and Gas Locations with significant potential Geologic Hazards may be included as part of an Alternative Location Analysis (ALA), if required to be submitted pursuant to Rule 304.b.(2).B. and 304.b.(2).C. The Geologic Hazard plan must present the Professional Geologist's opinion as to whether or not the Oil and Gas Location can be developed, if the Geologic Hazard(s) can be minimized or mitigated to allow for development, or if the location should not be developed.

5. The Geologic Hazard plan will include a list of best management practices (BMPs) to address how the Operator plans to minimize or mitigate identified

Geologic Hazard(s). This list is to be provided in a format that allows the BMPs to be copied onto the Form 2A.

# Additional Information

## Common Errors and Issues Encountered by ECMC Staff

1. Missing Professional Geologist signature.
2. Does not explain why the geologic feature is or is not a hazard to the location.
3. Does not list out all of the sources used for determining geologic features and hazards in an area.

## General Notes

1. All geology reports will be prepared by a Professional Geologist as defined by Colorado Statutes C.R.S. 23-41-208. A Professional Geologist is a person engaged in the practice of geology who is a graduate of an institution of higher education which is accredited by a regional or national accrediting agency, with a minimum of thirty semester (forty-five quarter) hours of undergraduate or graduate work in a field of geology and whose postbaccalaureate training has been in the field of geology with a specific record of an additional five years of geological experience to include no more than two years of graduate work.
2. Any report required by law or by rule and prepared as a result of or based on a geologic study or on geologic data, or which contains information relating to geology and which is to be presented to or is prepared for any state agency, political subdivision of the state, or recognized state or local board or commission, shall be prepared or approved by a Professional Geologist.
3. Under Rule 304.d. Lesser Impact Areas, the Director may exempt an Operator from submitting any of the information required by Rule 304.b., or any plan required by Rule 304.c., under the following circumstances:

A. Request an exemption from the Director based on evidence showing the plan is unnecessary because either the impacted resource or resource concerns are not present or impacts to the resource will be minimal and pose no concern.

B. Request an exemption from the Director in writing, without proceeding through the ordinary Rule 502 variance process. A request for an exemption will be provided with the Form 2A at the time the form is submitted.

C. The Director may grant an exemption as part of the completeness determination if the Director concurs with the Operator that providing the information or plan is unnecessary to protect and minimize adverse impacts to public health, safety, welfare, the environment, or wildlife resources.

D. If the Director grants an exemption, the Commission may nevertheless request the information or Plan, if the Commission determines that reviewing the information or Plan is necessary to protect and minimize adverse impacts.

4. The Relevant Local Government may have additional or different requirements, standards, qualifications, and definitions that pertain to preparation of geologic hazard reports and soil suitability for development. Report authors and applicants should be familiar with all federal, state, local, land use codes, policies, and regulations related to geologic hazards or soil suitability reports to ensure compliance and that geologic reports will be accepted for their intended purpose, or submitted as Substantially Equivalent.

5. The ECMC Online Interactive GIS Map provides information that can be used to identify Geologic Hazards in the vicinity of potential Oil and Gas Locations. Access the interactive map via the ECMC website under the Maps tab.

a. Once in the online map, and centered on the Location, find the "Geology" layer near the bottom of the layers list left of the map.

    i. Select either the 250K Geology Map or 500K Geology Map (Tweto 1979) to assess geologic units in the vicinity of the Oil and Gas Location.

        1. The 250K Geology Map also shows the presence of mapped faults and folds which may help in identifying potential geologic hazards.

    ii. Additionally, an Earthquakes (1973-Present) layer and CGS Landslides layer, and a 250K Geology Map Index are also presented in this folder and should be reviewed for these Geologic Hazards in the vicinity of potential Oil and Gas Locations.

    iii. Geology Map Legends are found on the ECMC home page under "Help" on the right hand margin of the page.

b. The Topography folder on the ECMC GIS Interactive Map contains topographic map layers. This folder is located below the Geology folder, and can aid in identifying steep slopes and other topographic features that may indicate the presence of Geologic Hazards that may adversely impact development of Oil and Gas Locations.

6. Review soil surveys prepared by the Natural Resources Conservation Service (NRCS) and soil map unit description for information about hydric, erodible, expansive, collapsible soils (hydrocompaction) that may affect construction, or corrosive soils that may affect steel or concrete. Corrosive soils have implications for cathodic protection requirements on well casings, cement, flowlines, pipelines, footings, or subsurface structures. Provide BMPs to manage these soil properties.

7. Develop minimization and mitigation measures including engineering and design plans for Oil and Gas Locations in proximity to steep slopes, talus covered slopes, areas with rockfall potential, or downslope from mudflow and debris fans. Provide minimization and/or mitigation measures as a list of BMPs for Geologic Hazards.

8. For Oil and Gas Locations in historic abandoned coal mining areas, provide a description of potential mine subsidence and measures taken to minimize or mitigate the hazard.

9. Onsite field studies, surveys, and/or geotechnical subsurface investigations may need to be performed on selected Oil and Gas Locations located within Geologic Hazard areas to develop site-specific minimization and mitigation BMPs or determine that development on a location should be avoided.

10. Evaluate areas for potential flooding, flash floods, slope failure, and debris flows. A Flood Shut-In Plan consistent with Rule 304.c.(9). and the requirements of Rule 421.b.(1). for these areas. In areas with less potential for flooding, permanent stormwater controls (such as diversion ditches and drainage pipes) may be required for slopes covered with unconsolidated materials.

11. Evaluate areas for bedrock faults, seismic activity, earthquakes and potential for induced seismicity for proposed Class II underground injection control (UIC) disposal well locations.

    a. If faults are identified, the Geologic Hazard Map and Plan should indicate:

        i. whether they are considered active or inactive,

        ii. an estimate of when faults were last active,

        iii. whether the fault trace is visible at the surface,

iv. the dip angle,

v. the relative fault displacement (i.e. upthrown block, downthrown block, or arrows showing direction of movement), and

vi. lateral displacement distance.

12. For areas with steep slopes, potential for rockfall or landslides, or steeply dipping bedrock, include strike and dip measurements for bedrock outcrops on the map or include the percent grade of the natural slope.

13. Some Colorado soils and bedrock contain elevated levels of naturally occurring metals such as arsenic, lead, and selenium. These may have implications for management of exploration and production (E&P) waste. Site-specific background sampling may be required to assess naturally occurring metal levels for waste management considerations under Rule 911.a.(4). and concentrations listed under Table 915.

14. Evaluate the potential for naturally occurring radioactive materials (NORM) and technologically enhanced radioactive materials (TENORM) to be present at a location and implications for E&P Waste generation and disposal.

    a. Radon levels need to be considered for locations that will have structures occupied by Operator personnel or contractors or potential exposures to public health, safety, welfare, the environment, and wildlife.

15. For Centralized E&P Waste Management Facilities (Rule 907.b.(7).A.), the facility design and engineering data should incorporate BMPs, including:

    a. plans and elevations;

    b. design basis;

    c. calculations;

d. geologic data, including, but not limited to, the type and thickness of unconsolidated sediment and soils;

e. type and thickness of bedrock, if applicable;

f. local and regional geologic structures; and

g. any geologic hazards that may affect the design and operation of the facility.

h. Refer to guidance documents for Centralized E&P Waste Management Facilities for more information.

16. Some geologic phenomena are usually not so adverse as to constitute a significant hazard and should not be defined as Geologic Hazards in most settings. These hazards should be shown on the map and should be addressed by the Professional Geologist as present but not posing a significant impact for development of the Oil and Gas Location. These geologic phenomena include:

    a. Floodplains - Construction in a floodplain or floodway is not always so adverse as to cause a significant hazard to development and *should not always be included as a Rule 304.b.(7).I. Geohazard*. Exceptions include construction in a floodway or in an area subject to flash flooding.

    b. Collapsible soils or expansive soils - Although widespread, these types of soils are not always so adverse as to cause a significant hazard to development and *should not always be included as a Rule 304.b.(7).I. Geohazard*. Exceptions include areas where terrain and soil thickness or structural issues result in unstable surfaces without mitigation.

    c. Corrosive soils - These types of soils are not always so adverse as to cause a significant hazard to development and *should not always be included as a Rule 304.b.(7).I. Geohazard*. Exceptions include areas where structural issues result in unstable surfaces without mitigation.

### Resources

ECMC recommends these external resources for use in the determination of the presence of geologic hazards. All information and updates are under the purview of each site's respective owner.

- Colorado Division of Homeland Security and Emergency Management, About DHSEM | Division of Homeland Security and Emergency Management (colorado.gov)
- Colorado Emergency Management Office Emergency Management Office | Division of Homeland Security and Emergency Management (colorado.gov)
- Colorado Geological Survey, Hazards - Colorado Geological Survey
- Colorado Geological Survey, HAZUS HAZUS - Colorado Geological Survey
- Colorado Geological Survey, Land Use Review Land Use Review - Colorado Geological Survey
- United States Geological Survey, Geologic Hazards Science Center (usgs.gov)

## Additional Information

### Common Errors and Issues Encountered by ECMC Staff

1. N/A

### General Notes

2. N/A

### Frequently Asked Questions

1. N/A

## General References

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# Document Change Log

| **Change Date** | **Description of Changes** |
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